BULLETIN

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Vol. XXXIV, 1915.

EDITOR, J. A. ALLEN.

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(*Continued from 3d page of cover.*)

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CONTENTS OF VOLUME XXXIV.

DATES OF PUBLICATION OF SEPARATA.

The edition of separata is 300 copies, of which about 100 are mailed on the date of issue, and the others placed on sale in the Library.

Art. I,	March	3, 1915.		Art. XIII,	Sept.	8, 1915.
" II,	"	3, 1915.		" XIV,	"	24, 1915.
" III,	"	3, 1915.		" XV,	Nov.	2, 1915.
" IV,	"	19, 1915.		" XVI,	Oct.	20, 1915.
" V,	"	19, 1915.		" XVII,	"	20, 1915.
" VI,	"	19, 1915.		" XVIII,	Nov.	2, 1915.
" VII,	"	19, 1915.		" XIX,	"	30, 1915.
" VIII,	May	17, 1915.		" XX,	Dec.	10, 1915.
" IX,	"	29, 1915.		" XXI,	"	10, 1915.
" X,	June	4, 1915.		" XXII,	"	30, 1915
" XI,	May	27, 1915.		" XXIII,	"	30, 1915.
" XII,	June	4, 1915.				

LIST OF ILLUSTRATIONS.

PLATES.

milleri; Figs. 19–20, *Guerlinguetus æstuans æstuans,* Figs. 21–22, *G. æstuans gilvigularis;* Figs. 23–24, *G. ingrami.*

XIV.— Maxillary teeth of South American Squirrels. Figs. 1–2, *Urosciurus duida;* Figs. 3–4, *U. igniventris igniventris;* Figs. 5–6, *Simosciurus stramineus stramineus;* Figs. 7–8, *Hadrosciurus flammifer.*

XV.— *Arctostylops steini,* lower jaw.

Text Figures.

LIST OF GENERA, SUBGENERA, SPECIES, AND SUBSPECIES DESCRIBED OR RENAMED IN THIS VOLUME.

Genera and Subgenera.

Species and Subspecies.

ERRATA.

Page 209, line 14, for T. Steinbach read J. Steinbach.
" 217, " 24, for 87 read 96.
" 254, " 9 from bottom, for *geurlingugus* read *guerlingus*.
" 290, Figs. 7, 8, for *satuensis* read *saltuensis*.
" 294, last line, for Simosciurus flammifer read Hadrosciurus flammifer.
" 541, line 12, for *tamama* read *temama*.
" 542, " 1, for calls read call.
" 545, " 1, for Gallers read Gallera.
" 549, " 7, for (just breaking through the alveolus) read (m^3 just breaking through the alveolus).
" 553, lines 5 and 6, for from original specimens, respectively from the two Tunkas, etc., read from the two original specimens, respectively from Tunkas, etc.
" 591, line 6, for *Chænius* read *Chlænius*.
" 610, line 3 from bottom, for succumbed read survived.

BULLETIN

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VOLUME XXXIV, 1915.

56.9.743(1181:78.7)

Article I.—A REVISION OF THE LOWER EOCENE WASATCH AND WIND RIVER FAUNAS.

BY W. D. MATTHEW and WALTER GRANGER.

Introduction.

IN 1891 the Department of Mammalian Palæontology of this Museum was founded by Professor Henry Fairfield Osborn. The first expedition for fossil mammals was sent out in charge of Dr. J. L. Wortman to the Lower Eocene Wasatch formation of the Big Horn Basin, Wyoming. The results of this auspicious beginning of the Museum's fossil-hunting expeditions were described in the 'Bulletin' for 1892, volume IV. Another very successful expedition was conducted by Dr. Wortman the next year into the Paleocene (Puerco) of New Mexico. In 1895 the Museum purchased the Cope Collection of North American Fossil Mammals, including the Eocene and Paleocene collections obtained by Professor Cope and his assistants and described and figured in 'Tertiary Vertebrata.' Expeditions in charge of Dr. Wortman in 1893–96 added largely to the Eocene collections thus brought together. In 1903 Mr. Walter Granger began a systematic and thorough search of the Middle and Lower Eocene and Paleocene formations of Wyoming and New Mexico which has continued for ten years with great success.

The thorough stratigraphic studies made by these expeditions and exact records of level and locality of every specimen, have made it possible to correlate the faunas and trace the evolution of the various races much more precisely and certainly. The great amount of new material, and more complete specimens of rare and little known species have as yet been described only in small part.

The present revision is concerned with the Lower Eocene faunæ, the

Wasatch and Wind River and their equivalents. Preliminary notes on the stratigraphy and correlation have been published by Sinclair and Granger, and the Artiodactyls have been revised in a recent paper by Dr. Sinclair in this 'Bulletin.' The systematic revision of the Amblypoda, Condylarthra, Perissodactyla, Tillodontia and Tæniodonta has been undertaken by Mr. Granger, of the Carnivora, Insectivora, Primates, Rodents, etc., by Dr. Matthew. Dr. W. K. Gregory will contribute a series of studies of the morphology and general relationships of some of the more important groups.

Through the courtesy of the United States National Museum, we have been accorded the exceptional privilege of borrowing for study and comparison the type specimens of fossil mammals from the New Mexican Wasatch described by Cope in 1874–77. The rest of the types from the Lower Eocene formations are in this museum, except for a number in the Amherst Museum and in the Marsh Collection at Yale University. Through the courtesy of Dr. Loomis, Dr. Schuchert and Dr. Lull we have been enabled to examine and study these types also. The Museum is largely indebted to Dr. W. J. Sinclair of Princeton University for valuable services in the field, both in stratigraphic work and collecting, as well as for the published contributions above noted. The success of Mr. Granger's expeditions is in no small part due to the coöperation of his able and energetic assistants now or formerly on the Museum staff, Messrs. George Olsen, William Stein, Paul Miller, C. Forster Cooper and P. L. Turner, who have been attached to one or more of the parties in the Lower Eocene formations. Following is a summary of the earlier and later explorations in these horizons:

(1) Typical Wasatch, near Evanston, Wyoming. Fossils first found in 1871 by Wm. Cleburne. These and some other specimens obtained in 1872–73 by Professor Cope are in the American Museum collection. A number of specimens were secured subsequently by Professor Marsh and are now in the Yale Museum. Systematically explored by Granger in 1906,[1] and a small collection secured. The exposures are limited and fossils scarce.

(2) New Mexican Wasatch. San Juan Basin, in Rio Arribas Co. Explored by Cope for the Wheeler Survey in 1874 and an important collection made which is now in the U. S. National Museum. A few specimens collected for Professor Marsh about 1875–76 are in the Yale Museum. Dr. Wortman conducted a party in these beds in 1896 for the American Museum, but only a few specimens of any value were obtained. Systematically explored by Granger in 1912 and 1913 with considerable success.

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[1] The stratigraphy was revised by Veatch in 1904 for the U. S. Geological Survey.

(3) Black Buttes (margin of the Washakie Basin) Wyoming. A few fragmentary Wasatch fossils obtained in this vicinity by Cope in 1872 and by Marsh a few years later. No subsequent collecting.

(4) Wind River Basin, Wyoming. A valuable collection obtained by Wortman for Cope in 1880, including the famous *Hyracotherium venticolum* skeleton. Wortman obtained a number of specimens for the American Museum in 1891 and again in 1896. In 1904 Dr. Loomis led a successful expedition for Amherst College, and in 1905 and 1909 the formation was systematically searched by Granger for the American Museum and large although mostly fragmentary collections obtained. Wortman's collections were made in the upper levels of the formation, Loomis's in the lower horizon; Granger's material is from all the fossiliferous horizons.

(5) Big Horn Basin, Wyoming. This is by far the richest region for Wasatch fossils, the beds being extensively exposed and fossils often fairly common, although rarely complete or perfectly preserved. It was discovered by Dr. Wortman in 1881 and a large collection obtained for Professor Cope including the famous skeletons of *Phenacodus*. In 1884 a party from Princeton University obtained a small collection. In 1891 and 1896 Wortman again explored it in the interests of the American Museum obtaining many valuable specimens. In 1904 Loomis obtained a considerable collection for Amherst Museum. In 1910, 1911 and 1912 Granger searched the formation systematically with great success, his collections exceeding in amount and value all those previously obtained. In 1913 Mr. Stein completed the exploration of the basin under Granger's direction.

6. Clark Fork Basin. A small basin adjoining the Big Horn to the northwest, but draining independently into the Yellowstone River, and apparently semi-distinct in its Lower Eocene deposition. It was visited by Wortman in 1896, but the first fossils of any importance were obtained by Granger in 1911–12 and by Stein in 1913. The earliest Wasatch and sub-Wasatch beds are best represented in this basin, containing many new and primitive species herein described.

Most of the above collections are in the American Museum; the remainder in the National, Yale, Amherst and Princeton museums. I do not know of any other Lower Eocene fossil mammals in this country, save for a few specimens from the Uinta Basin in the Carnegie Museum at Pittsburgh. A number of field parties of the U. S. Geological Survey have made important contributions to our knowledge of the stratigraphy of these Lower Eocene formations, but none so far as I am aware have obtained any considerable collections of their fossil vertebrates.

From the lower Eocene (Suessonian) formations of England, France and Belgium a small mammalian fauna has been obtained. It is closely allied to the Wasatch faunæ and most if not all of its genera are represented by more perfect material of related, possibly identical, species in this country.

The lower Eocene mammals of the rest of the world are totally unknown.[1]

This series of contributions deals therefore with practically all that is known to science of the Lower Eocene mammalia. The authors, while in entire accord as to their conclusions, are separately responsible for the sections of the revision appearing under their individual names, and it is requested that they be so quoted.

PART I.—ORDER FERÆ (CARNIVORA). SUBORDER CREODONTA.

By W. D. Matthew.

The Creodonta of the Eocene form a relatively compact order, whose affinities are well understood, owing chiefly to the more or less complete knowledge of the skeleton of the principal genera. The affinities and classification of the several families were discussed at some length by the writer, in the memoir on the Bridger Carnivora and Insectivora.[2] The new material from the Lower Eocene confirms in detail the views there set forth, and illustrates very clearly the progressive stages in the differentiation of the several groups during the successive horizons of the Lower Eocene. The more complete material now at hand clears up the affinities of several doubtful groups, notably of the Oxyclænidæ, some of which at least appear to be nearly related to the Arctocyonidæ. These two families should probably be united, but a further study of the Paleocene Creodonta with the new and more complete material now at hand is desirable before this change is made.

Only one Paleocene Creodont has been known hitherto to survive into the Wasatch formations. To this genus, *Didymictis*, we are now able to add two others, *Dissacus* and *Chriacus*, while the new genus *Thryptacodon* is distinctly a Paleocene type. No trace of any Pseudocreodine genus is found in the Paleocene except in the transitional Clark Fork beds, but the Eucreodi and Acreodi of the older Torrejon and Puerco faunas are more nearly related to those of the later horizons than had previously appeared.

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[1] The Notostylops fauna of Patagonia I regard as late Eocene if it is a faunal unit at all.

[2] Carnivora and Insectivora of the Bridger Basin, Middle Eocene. By W. D. Matthew. Mem. Am. Mus. Nat. Hist., Vol. IX, part vi, August, 1909.

Key to the families of Creodonta.

A. *Procreodi.* Ungual phalanges fissured or unfissured, but not flattened.
  1. No carnassials.............................*Arctocyonidæ, Oxyclænidæ.*
B. *Eucreodi.* Ungual phalanges not fissured.
  2. Carnassial teeth p^4 and m^1......................................*Miacidæ.*
C. *Pseudocreodi.* Ungual phalanges fissured.
  3. Carnassial teeth m^1 and m_2...................................*Oxyænidæ.*
  4. Carnassial teeth m^2 and m_3.............................*Hyænodontidæ.*
D. *Acreodi.* Ungual phalanges fissured and flattened.
  5. No carnassials.......................*Mesonychidæ* and *Triisodontidæ.*

OXYCLÆNIDÆ *Scott* 1892.[1]

Chriacus *Cope* 1883.[2]

Type, C. pelvidens (Cope 1881 [3]) from Torrejon of New Mexico.

This genus is common in the Torrejon but not hitherto discovered in the Wasatch. As with most of the Paleocene mammals its systematic status has been doubtful. Cope and Scott referred it to the Creodonta; Osborn and Earle in 1895 [4] tentatively referred it to the Primates, to which Scott had suggested that it was probably related. Matthew in 1897 and subsequently, referred it to the Creodonta more or less provisionally as a member of the primitive family *Oxyclænidæ.* Wortman in 1902 [5] suggested that this family might prove to be of Insectivore affinities "with numerous transitional or Metatherian characters." The specimen described below affords some important evidence as to the affinity of this genus. The construction of the manus is completely in accord with the less specialized Creodonts, as are also the parts preserved of the hind foot. While not wholly conclusive, the evidence is decidedly in favor of the Creodont affinities of *Chriacus.*

A subfamily distinction from the Arctocyoninæ is perhaps afforded by the reduced and non-opposable pollex in this genus. The hallux is unreduced, and compares with Miacinæ and Arctocyonidæ.

The characters of the manus exclude *Chriacus* from the Primates to which it was tentatively referred by Osborn and Earle, and make it very improbable that it has any Insectivore affinities.

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1 Proc. Acad. Nat. Sci. Phila., Vol. XLIII, p. 294.
2 Proc. Acad. Nat. Sci. Phila., Vol. XXXIV, p. 80.
3 *Lipodectes pelvidens* Cope 1881, Amer. Nat., Vol. XV, p. 1019.
4 Bull. Am. Mus. Nat. Hist., Vol. VII, p. 20.
5 Am. Jour. Sci., Vol. XIII, p. 434, footnote.

Chriacus gallinæ sp. nov.

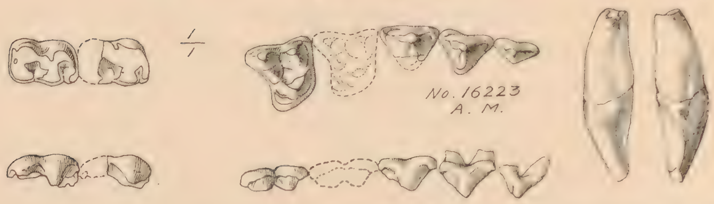

Fig. 1. *Chriacus gallinæ*, upper and lower teeth of type specimen, natural size, crown and outer views of m_{1-2}, p^2–m^2, and inner and outer views of upper canine. Almagre beds, Wasatch formation of San Juan Basin, New Mexico.

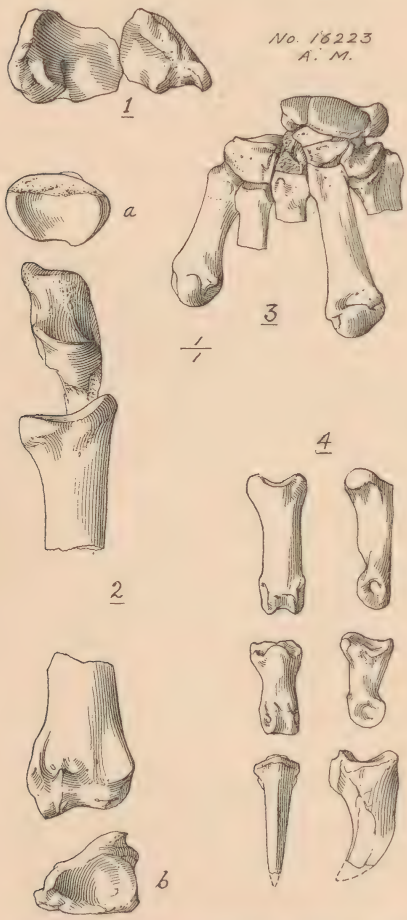

Fig. 2. *Chriacus gallinæ*, parts of limb bones and fore foot, natural size: 1, distal ends of tibia and fibula; 2, radius and ulna, *a*, head of radius, *b*, distal end of radius; 3, dorsal view of carpus and metacarpus, lacking cuneiform and ends of three metacarpals; 4, phalanges, dorsal and lateral views. All from the type specimen.

Type, No. 16223, upper and lower teeth, fore feet and various skeleton fragments, from the lower division of the New Mexican Wasatch.

Specific distinctions: Size of *C. pelvidens;* paraconid of lower molars stronger, more internal in position; external cingulum of upper molars weak; p^3 without deuterocone and protocone of more trihedral form.

Diagnosis of skeleton parts. The head of the radius is round oval, not flattened; the bicipital tubercle elongate, not prominent; the distal end of radius trihedral, styloid process weak. The olecranon is short, expanded laterally, not deep; sigmoid cavity rather shallow. Scaphoid, lunar and centrale separate, the scaphoid shallow, centrale larger than in Oxyænidæ otherwise similar, trapezoid wider and deeper than in Oxyænidæ and Miacidæ, trapezium smaller and more quadrate, lacking the inferior peg characteristic of the Arctocyonidæ and present to a less extent in the other families. The magnum is high and narrow, its proximal keel compressed and obliquely set in relation to the body. The unciform is of moderate height with a rather narrow subproximal lunar facet.

The metacarpals are five in number, the fifth having the most robust shaft, mc.I the most slender; mc.II is considerably longer than mc.V, the shaft somewhat slenderer; the shafts of mc.III and IV are smaller, that of mc.I much smaller, but their lengths are not preserved.

The phalanges are very like those of

Vulpavus except that the unguals are longer, not quite so high and compressed, the sub-ungual processes heavier.

The entocuneiform is as broad as in *Vulpavus* but lacks the characteristic asymmetry of that genus; it is broader than in *Didymictis* and decidedly broader than in Oxyænidæ.

The middle caudals are long and heavy.

Thryptacodon gen. nov.

Type, T. antiquus, infra.

Generic characters: Upper molars low-crowned, quadrate-oval or rounded, cusps round conic, hypocone prominent on m^{1-2}, enamel rugose, $m\frac{3}{3}$ somewhat reduced, round oval; p^4 trihedral with small deuterocone, distinct para- and metastyles. Lower molars broad with very small submedian paraconid and four sub-equal opposite principal cusps. Heavy external cingula on lower molars; heavy encircling cingula on upper molars. Anterior premolars slender; canines long, compressed and ridged posteriorly. Skull short with comparatively large brain-case, skeleton relatively large, resembling that of Miacinæ.

This genus is not rare in the lower horizons of the Big Horn Wasatch, but has not been found in the Lysite or Lost Cabin. It appears to be related to *Tricentes* and *Chriacus,* but has more rounded teeth than the former, $m\frac{3}{3}$ more reduced; differs from *Chriacus* in the lower cusps, broad rounded teeth, rugose enamel and heavy cingula. It approaches the Arctocyonidæ more nearly than do any other Oxyclænids, but is less specialized and the skull and skeleton are more progressive. The very marked detailed resemblance to *Clænodon* in the construction of the molar teeth can hardly be interpreted otherwise than as proof of close affinity, and makes the propriety of separating Oxyclænidæ and Arctocyonidæ as distinct families very questionable. There is a notable difference indeed in the form and proportions of the skull and in the proportions of the skeleton. But it is not as wide as between *Didymictis* and *Palæarctonyx* in the Miacidæ.

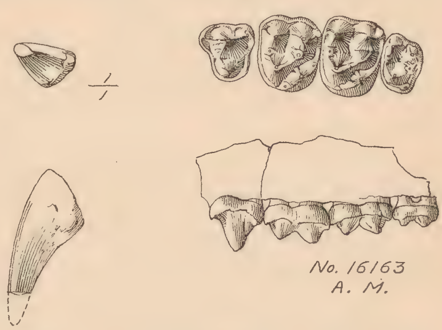

Fig. 3. *Thryptacodon olseni,* upper teeth, crown and external views, natural size. No. 16163, Gray Bull beds, Big Horn Basin, Wyoming.

In size and general proportions of the teeth these two species are not unlike *Palæosinopa.* The detail construction of the molars easily distinguishes the two genera. In *Palæosinopa* the cusps are decidedly higher, more angulate, the paraconid more prominent, placed nearer to the inner border, trigonid distinct from talonid, heel of m_3 longer with high hypoconulid and entoconid. There are no cingula on the molars and the posterior mental foramen is beneath m_1. The upper molars show corresponding differences, being in *Palæosinopa* triangular in outline, with high sharp protocone, hypocone represented only by a cingular flange, paracone and metacone smaller, sharper, somewhat inset from the border, and with small stylar crests at the anterior and posterior angles. The deuterocones of the premolars are also better developed, and the last molar is transverse.

In all these characters of the teeth *Palæosinopa* comes decidedly nearer to the Miacidæ than does *Thryptacodon.* But the skeleton of the new genus is that of a Creodont, related to the Miacidæ and Arctocyonidæ, whereas the skeleton of *Palæosinopa* is widely different from the Creodont type, and agrees nearly with that of the Insectivore *Pantolestes.* The distinctions in the teeth are therefore not to be regarded as of ordinal value.

Two species or subspecies are represented in the collection, distinguished as follows:

T. antiquus: $m^{1-3} = 17.5$ mm.; upper molars round-quadrate, no hypocone on m^3, no protostyles.

T. olseni: $m^{1-3} = 21$ mm., upper molars quadrate, distinct hypocone on all, protostyle on m^{1-2}, deuterocone of p^4 larger.

Thryptacodon antiquus sp. nov.

Type, No. 16162, upper and lower jaws and parts of radius and ulna, from the Systemodon zone in Clark Fork Basin, Wyoming.

Distinctive characters: Upper molars round-oval, with low rounded cusps, heavily cingulate, enamel rugose, distinct hypocone on m^{1-2}, none on m^3, conules distinct but small. P^{3-4} trihedral, three-rooted, strong deuterocone on p^4, none on p^3. Lower molars broad, low cusped, with heavy external cingula, paraconid much reduced, submedian, protoconid and metaconid equal and opposite, heel wide-basined, with hy^d and en^d strong, wider apart on m_{1-2} than the trigonid cusps, hypoconulid rudimentary except on m_3, in which it is moderately large median-internal. Heel of m_3 and m^3 reduced in size. Posterior lower premolars short and robust with small heels and anterior basal cusps and heavy cingula. P_2 two-rooted, slender, p_1 one-rooted. Canines moderately large, slender, ridged posteriorly.

Thirteen specimens from the Sand Coulée and Gray Bull horizons in the Big Horn and Clark Fork basins represent this species, all agreeing quite closely in size and characters. Two jaw fragments with m_{2-3} from the Clark Fork beds probably represent a distinct species or subspecies, distinguished by broader teeth and a distinct protostyle on m_2, but the material seems inadequate for a specific type.

These teeth are very suggestive of *Tricentes*, but the molars are more rounded in outline, $m\frac{3}{3}$ more reduced, and the size is greater. In many features they also suggest *Clænodon* and *Palæarctonyx,* but the cusps although low, are not flattened out as in those genera, the proportions of the

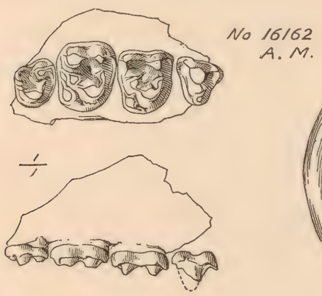

Fig. 4.

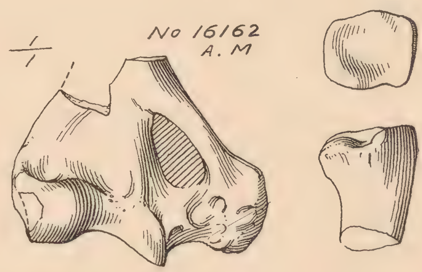

Fig. 6.

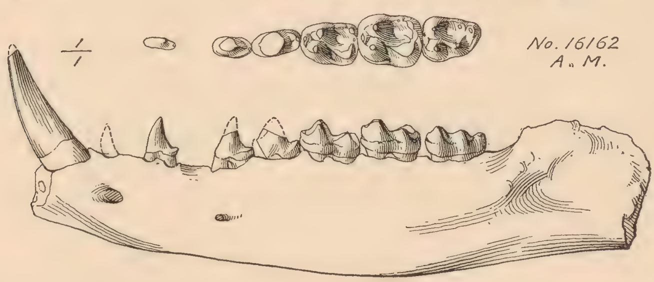

Fig. 5.

Fig. 4. *Thryptacodon antiquus*, upper teeth outer and crown views of p^4–m^3 and outer view of upper canine, natural size. Type specimen, Gray Bull beds, Clark Fork Basin, Wyoming.

Fig. 5. *Thryptacodon antiquus*, lower jaw, outer view, and crown view of lower teeth, natural size. Type specimen, Gray Bull beds, Clark Fork Basin, Wyoming.

Fig. 6. *Thryptacodon antiquus*, type specimen, distal end of humerus and proximal end of radius, natural size. Gray Bull beds, Clark Fork Basin, Wyoming.

molars are different. But there is probably a near affinity between the less specialized Arctocyonidæ, the Cercoleptoid Miacidæ and the Oxyclænidæ, although part of the resemblance is due to parallelism.

Thryptacodon olseni sp. nov.

Type, No. 15252, a skull and large part of the skeleton, found by Mr. George Olsen a few miles east of Saint Joe in the Gray Bull horizon of the Wasatch.

The specimen is poorly preserved, and more or less encrusted with a flinty matrix. It consists, besides the skull, of eighteen vertebræ, most of the limb bones and an incomplete fore foot. A second specimen No. 16163, upper jaws with well preserved teeth, is referred to this species but has more rounded teeth, approaching *P. antiquus* in this respect.

Skull. Owing to the poor preservation no sutures can be safely distinguished. The general proportions of the skull are much as in *Vulpavus.* The frontal region appears to be wider than in that genus, the front of muzzle broader. The sagittal crest is of moderate height, the occiput appears to be broad and low, and the brain-case is fairly capacious, comparing with *Vassacyon,* smaller relatively than in *Vulpavus* but much larger than in

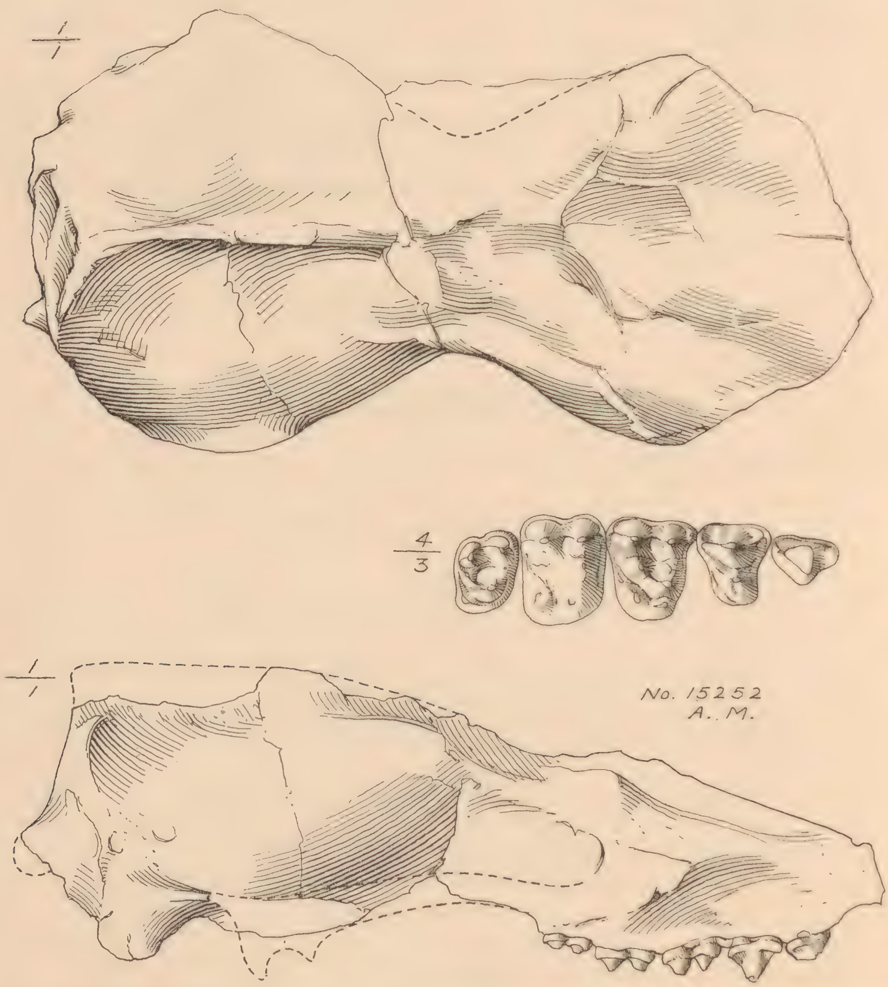

Fig. 7. *Thryptacodon olseni,* skull, top and side views natural size, and crown view of upper teeth, four-thirds nature. Type specimen, Gray Bull beds, Big Horn Basin, Wyoming.

Arctocyon and materially larger than in *Didymictis.* The basicranial region appears to be shorter than in *Didymictis* and *Vulpavus;* the bulla is absent as usual, the auditory prominence large and prominent (? owing to crushing). In other respects it accords with *Vassacyon* so far as comparisons can be made.

Dentition. The anterior teeth cannot be determined with certainty. There is a pair of large, stout, oval canines, apparently little curved, and in front of them are at least two unusually large incisive alveoli. The first two premolars are indeterminate, the third is of moderate size without inner cusp but triangular in outline. The fourth premolar has a triangular protocone, strong, well separated deuterocone, external, internal and posterior cingula. The true molars are of subquadrate outline, one-fourth greater in transverse than in antero-posterior diameter, with low rounded conic cusps of equal height and an encircling cingulum. The second molar is a little larger than the first, the third much smaller. Paracone and metacone are close to the external margin, rounded, protocone more trihedral, metaconule moderately developed, paraconule rudimentary, hypocone prominent and distinct, extended anteriorly on m^{1-2} in a strong shelf internal to the protocone. In all three the hypocone is developed from the internal cingulum.

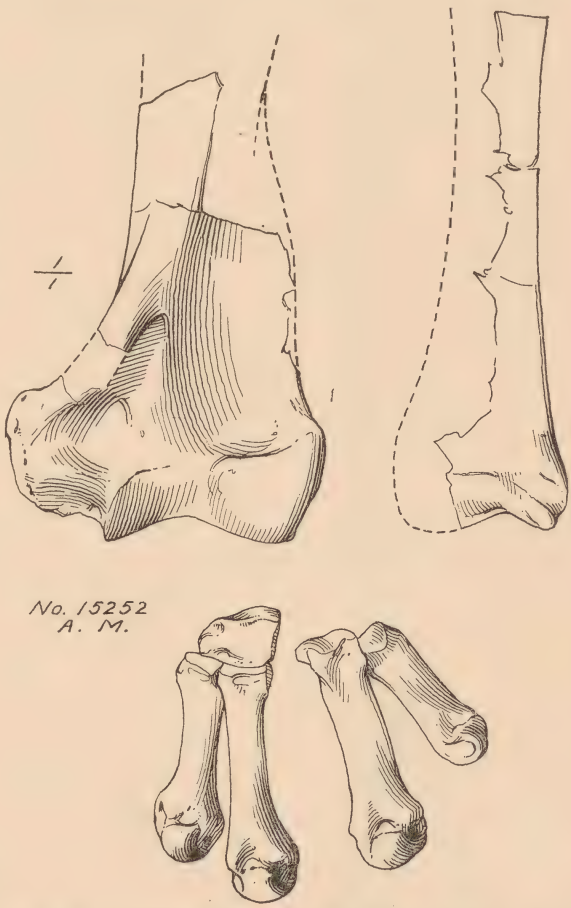

Fig. 8. *Thryptacodon olseni*, parts of fore limb: anterior view of distal ends of humerus and radius, dorsal view of metacarpus, with unciform, lacking digit III. Natural size, type specimen.

The measurements of the skull and teeth are about one-fifth greater than those of *Vulpavus profectus*, while the limbs are about one-half greater.

Vertebræ. The vertebræ are at present so much buried in matrix that a detailed description is not possible.

Limb bones. The humerus is like that of *Arctocyon* and the Cercoleptoid Miacidæ. The deltoid crest is shorter and more abruptly ended than in *Vulpavus*, the radius facet less convex from side to side.

The femur has a third trochanter, but quite small. The patellar trochlea is longer than in *Vulpavus* and *Palæarctonyx*. The shaft of the radius is smaller in proportion to the ulna, and the shaft of the fibula is larger in proportion to the tibia than in the Miacidæ; the distal facets of tibia and fibula are somewhat more oblique and the astragalar trochlea of the tibia is

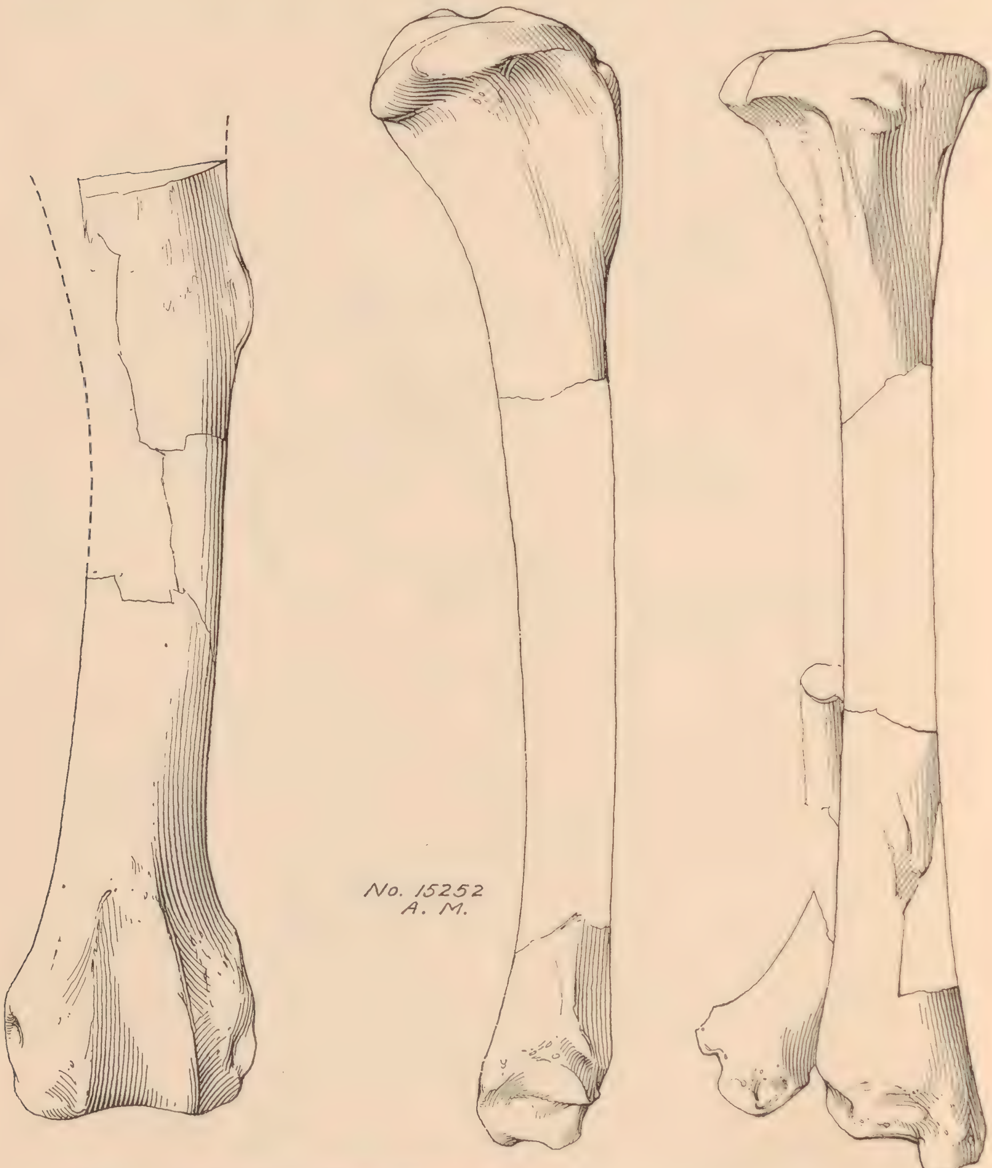

Fig. 9. *Thryptacodon olseni*, hind limb bones natural size, front view of femur, inner and front views of tibia, the latter with fibula somewhat displaced in matrix. Type specimen.

less excavated than in *Vulpavus*. The styloid process of the radius is less prominent. In all these features it approaches more nearly to the Arctocyonidæ.

Fore foot. The unciform and mc. I, II, IV and V are preserved. They are notably more robust than in *Vulpavus* as well as of larger size. The trapezoid facet of mc.II faces proximad instead of intero-proximad as in *Vulpavus;* the facet of mc.I for the trapezium likewise lacks the obliquity of the corresponding facet of mc.I on *Vulpavus.* These features indicate a less prehensile hand. The unciform is remarkably different from the known Miacidæ and Arctocyonidæ in that it appears to indicate a serial carpus, there being no proximal facet for the lunar. There is a single proximal facet for the cuneiform, notable chiefly for its extent; a distal facet for mc. IV–V, imperfectly divided; and three internal facets, for mc.II, magnum, and centrale or lunar or both.

Measurements.

Length of upper cheek teeth p^3–m^3						31.8
Diameters of	p^3	anteroposterior	4.5	transverse	4.1	
"	" p^4	"	5.8	"	6.5	
"	" m^1	"	6.8	"	8.2	
"	" m^2	"	6.7	"	8.8	
"	" m^3	"	5.0	"	7.	
"	" c^1	"	6.2	"	5.	
Length of skull from p^3 to mastoid process						80
Width of skull at prefrontal processes						43.5
Width of skull at postorbital constriction (this and the preceding dimension are much exaggerated by the crushing of the skull)						27.5
Width of brain-case						45.3
Humerus, length from distal end to apex diameter of deltoid crest						66.8
" diameter of distal end						38.0
Femur, length from distal end to apex of 3d trochanter						97.5
Radius, diameters of head, 13.5×14.						
" shaft one-fourth down 8.5×5.5.						

ARCTOCYONIDÆ.

Anacodon *Cope* 1882.[1]

Type, A. ursidens from Lysite of Big Horn Basin, Wyoming.

Generic characters: Crowns of molar teeth flattened, rugose, cusps obscured, premolars $\frac{2}{2}$ much reduced. Lower jaw flanged anteriorly, canine and incisors reduced and crowded, upper canine probably laniary.

Three additional specimens of this rare genus were secured by Mr. Granger in Wyoming and one in New Mexico. The Wyoming specimens are from the Lysite and uppermost Gray Bull zones, the New Mexican

[1] Proc. Am. Phil. Soc., Vol. XX, p. 181. Pal. Bull. No. 34.

specimens from the upper part of the Lower Wasatch. The matrix of the type specimen of *A. ursidens* as well as those referred to this species by Osborn in 1892 indicate that they are also from the Lysite horizon.

The new material shows that the lower jaw of *Anacodon* was heavily flanged at the chin as in the Machærodonts, the lower canine and incisors reduced and compressed even more than in *Hoplophoneus.* This probably indicates a large compressed sabre-like upper canine.

The specimen from the Lysite indicates a larger but more primitive species than *A. ursidens.* The New Mexican specimen is smaller than any of those from Wyoming and is perhaps a more primitive mutant, but is referred to Cope's species.

The flanged lower jaw is a quite unexpected character in this genus, for no trace of this specialization is present in *Clænodon* nor as far as I know in *Arctocyon.* It points evidently to some highly specialized food-habits, but is not comparable with that of the Machærodonts nor with the Oxyænid genus *Machæroides,* since it is here associated with frugivorous or omnivorous cheek teeth. *Bathyopsis* and *Uintatherium* are similarly flanged, but there is no close parallelism in the cheek teeth.

Anacodon ursidens *Cope* 1882.

Anacodon ursidens Cope 1882, Pal. Bull. No. 34, Proc. Am. Phil. Soc., Vol. XX, p. 182; 1885, Tertiary Vertebrata, p. 427, pl. xxve, fig. 2; Osborn (& Wortman), 1892, Bull. Am. Mus. Nat. Hist., Vol. IV, p. 115, fig. 13.

Type, No. 4261, parts of lower jaws from the Wasatch of the Big Horn Basin, Wyoming.

Distinctive characters: $m_{1-3}=38$. P^4 rounded, subquadrate, with low protocone and deuterocone and distinct tritto- and tetartocone. Molars with rounded outline, cones low, much obscured by surface rugosities.

To this species is referred in addition to the specimens described by Osborn a lower jaw, No. 15711, from the top of the Gray Bull beds near Fenton in the Big Horn Basin. The greater part of the left ramus and about half of the right ramus are preserved. The jaw deepens anteriorly, and shows a sharply marked, broad, thin and deep dependent flange; the anterior part of the jaw is concave externally, the flange bordered anteriorly by a strong crest which runs up to the canine alveolus. The canine alveolus is relatively small and much compressed, the incisive alveoli are obscurely indicated but were evidently small, laterally compressed and crowded out of series. Behind the canine is a long diastema followed by the vestigial p_3 and small two-rooted p_4. M_1 is much smaller than m_2, m_3 somewhat smaller. The jaw becomes shallower but much thicker under the posterior molars.

The masseteric fossa is deep and extends forward to a point beneath the posterior end of m_3, bounded inferiorly by a well defined ridge and antero-superiorly by the high crest which runs upward to the anterior margin of the coronoid process.

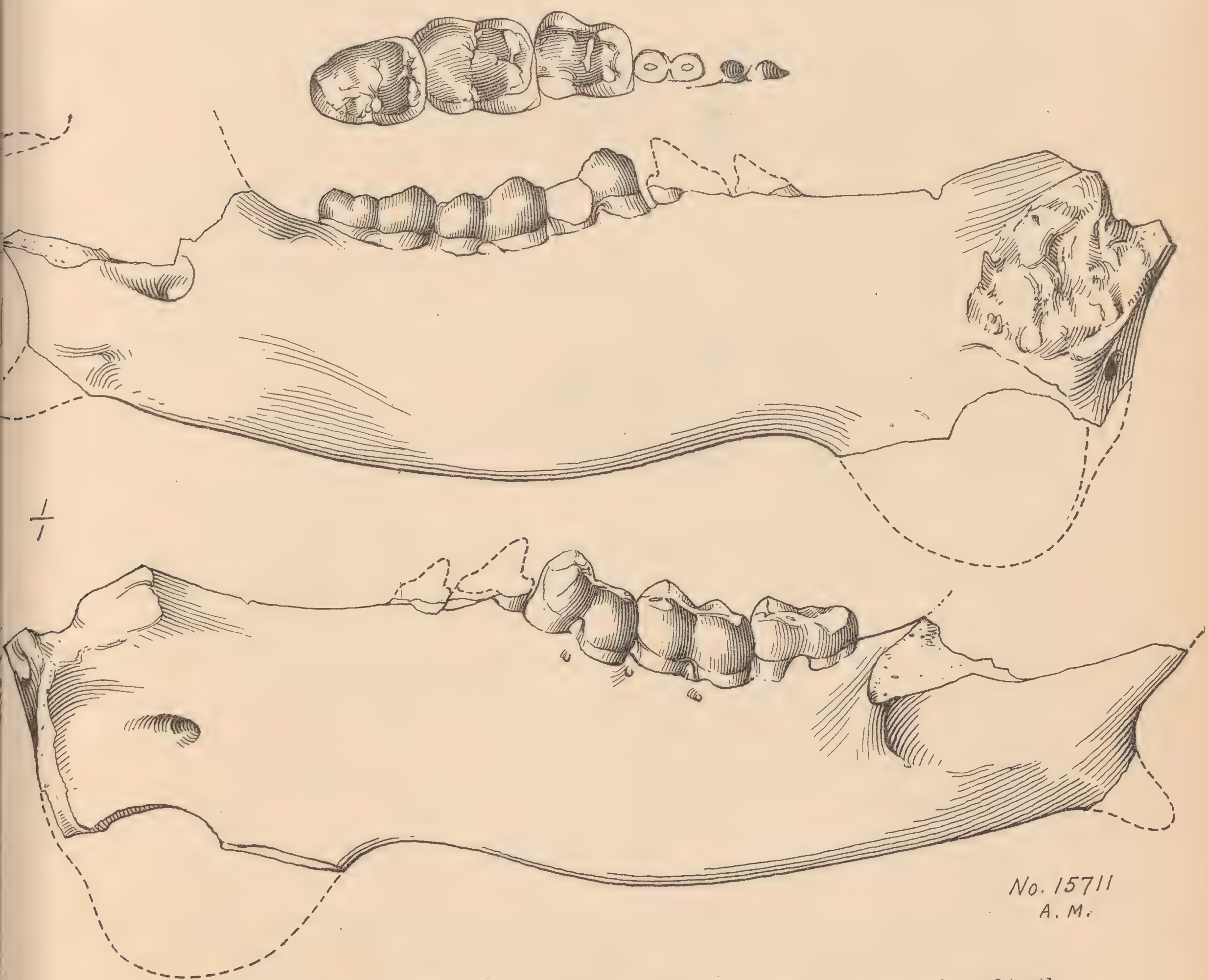

Fig. 10. *Anacodon ursidens*, lower jaw, inner and outer views and crown view of teeth, natural size. No. 15711, top of Gray Bull beds, Big Horn Basin, Wyoming.

No. 16781, lower jaw fragments with p_4–m_3 perfect and unworn, agrees with the described specimens save for smaller size. It is from the Upper Gray Bull horizon at head of Ten-Mile Creek in the Big Horn Basin.

The New Mexican specimen consists of parts of the lower jaw with m_{2-3} of the left, and m_1 and m_2 of the right side; it is slightly smaller and the teeth appear somewhat more primitive than *A. ursidens* from Wyoming, except No. 16781.

Anacodon cultridens sp. nov.

Type, No. 15638, upper and lower jaws from Lysite beds of the Big Horn Valley, at the head of Fifteen-mile Creek.

Distinctive characters: $m_{1-2}=50$; p^4 subtrigonal with cusps higher than in *A. ursidens*, no trittocone or tetartocone; molar cusps less flattened or obscured by crenulations.

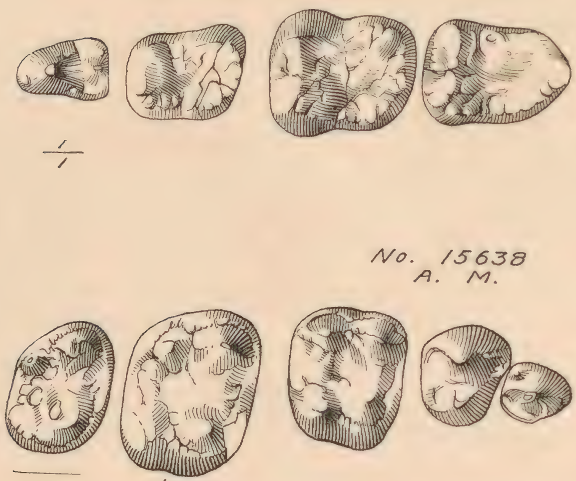

Fig. 11. *Anacodon cultridens*, upper and lower cheek teeth, crown views, natural size. Type specimen, Lysite beds, Big Horn Basin, Wyoming.

This species is about one-fourth larger in lineal measurements, but more primitive in the construction of molar and premolar teeth. The jaw is flanged anteriorly, but the flange does not appear to be so deep as in *A. ursidens*. The specimen consists of upper and lower jaws apparently with some fragments of the skull, but the bone is badly preserved and obscured by hard matrix, so that little can be determined with certainty beyond the characters of the premolars and molars, p^2–m^3, p_4–m_3 which are in good preservation.

MIACIDÆ.

This family is represented by six genera and fourteen species in the Lower Eocene formations. Four of the genera survive into the Middle Eocene. The Miacidæ are a group of genera divergently specializing into predaceous and frugivorous adaptations, ancestral to the Fissipede carnivora, and to some extent foreshadowing their broader groups. In the Lower Bridger they are divided primarily into two groups, the Viverravinæ with one genus *Viverravus*, and the Miacinæ with *Uintacyon, Miacis, Oödectes* and *Vulpavus*. Following these divisions down into the Wasatch horizons, we find the Viverravinæ (represented by *Viverravus* and *Didymictis*) still well distinguished from the Miacinæ (represented by *Uintacyon, Miacis, Vassacyon* and *Vulpavus*), but the genera of each group approximate, especially towards the base of the Wasatch, so that it becomes much more difficult to distinguish the species and assign them to their proper genera. The Lower Eocene species of the family are far less divergent than those of the Bridger, and often combine in varying proportions distinctive characters which in the Bridger stage have become sorted out into well differentiated and distinct genera. In 1909 I based a new genus, *Vassacyon,* upon one of these Wasatch species which combined characters of *Miacis, Vulpavus* and *Uintacyon* and referred the remaining described species to those genera to whose type species they appeared to be most nearly related. I knew at that time of a number of undescribed species from the Lower Eocene, but postponed description until more and better material should be at hand as a result of Mr. Granger's expeditions. This new material confirms the arrangement made in 1909, but shows that in addition to the four genera there noted, two others are represented. In every case the species, and especially the species or mutants from the older horizons, are more or less synthetic in type.

Had we to deal with the species of *Didymictis* and *Viverravus* from the Gray Bull, it would be natural to put them under a single genus. But the Lost Cabin species fall into two well distinguished genera. Similarly, if we had to deal only with the Gray Bull species of Miacinæ, they might well be included under a single, rather broadly inclusive genus, while the Middle Eocene species fall into four clearly distinct generic groups. It might seem that the affinities of the Lower Eocene species would be better expressed by so uniting them into a single primitive genus from which the specialized genera of the Middle Eocene could be derived. But I have failed to find any primitive characters which would serve to define such a genus in distinction from the Middle Eocene genera already described, and have therefore been compelled to distribute the Lower Eocene species for the most part, among the specialized genera. That is to say, the evolution of the several Miacid phyla was divergent, and not to any extent parallel progressive.

The affinities of the phyla as illustrated by the known species with their geological range appear to be about as follows: *Miacis* represents the central type, from which have diverged a number of specialized phyla, some becoming more predaceous, others frugivorous or omnivorous, as indicated by the teeth and other adaptive features of skull and skeleton. Of these, *Didymictis* is the earliest, and presents a succession of species of progressively larger size and with the carnassial dentition more differentiated, but retaining the tubercular dentition much as in *Viverra. Viverravus* is an allied phylum paralleling some of the smaller modern Viverridæ, with the tubercular dentition more reduced; its earlier species show a much more marked approach to the Miacinæ in the premolar teeth than do the earlier species of *Didymictis*. *Uintacyon* is nearly allied to *Miacis* but with trenchant heels on the molars, and progressively reduced premolars. It is intermediate in numerous particulars between *Viverravus* and *Miacis*. The central genus *Miacis* diverges in the later Eocene into a number of subgenera, the genus thus repeating the differentiation which the family Miacidæ underwent at an earlier stage. *Vassacyon* and *Vulpavus* are specializations from the *Miacis* type towards a more frugivorous mode of life paralleling the Procyonidæ especially *Cercoleptes*[1]; the Lower Eocene species are closely allied to those of *Miacis* but *Vulpavus* is more divergent in the Middle Eocene, paralleling *Procyon* and differentiating into subgenera; *Palæarctonyx* is a more extreme frugivorous adaptation, paralleling *Cercoleptes,* and probably derived from some species of *Vulpavus*. *Oödectes* seems to be another specialization from *Miacis* in somewhat the same direction, but with suggestions of insectivorous adaptation.

The Arctocyonidæ represent one or more earlier specializations in the same direction as these Cercoleptoid and Procyonoid Miacidæ. But they are derivatives not from the *Miacid* type, but from an earlier evolutionary stage in which the carnassial dentition had not yet specialized. In adaptation, *Clænodon, Thryptacodon* and *Vulpavus* correspond rather closely; so do *Anacodon* and *Palæarctonyx*. But they belong evidently to different phyla.

Key to Genera of Miacidæ.

A. Antero-external cusp of p^4 prominent. Molars $\frac{2}{2}$, m_2 elongate oval.
- B. Lower molars with basin heels . . . . *Didymictis.*
- BB. Lower molars with trenchant heels . . . . *Viverravus.*

AA. Anteroexternal cusp of p^4 weak or absent. Molars $\frac{3}{3}$, m_2 and m_3 short-oval or round.
- B. Carnassials well differentiated, p^4 extended postero-externally, trigonid of of m_1 high, of m_{2-3} low.
  - C. Lower molars with trenchant heels . . . . *Uintacyon.*
  - CC. Lower molars with basin heels.
    - D. M_2 and m_3 and heel of m_1 relatively small, premolars unreduced. *Miacis.*
    - DD. M_2 and heel of m_1 large, premolars reduced . . . . *Vassacyon.*
- BB. Carnassials little differentiated, p^4 not extended posteroexternally, trigonids of molars similar.
  - C. Lower molars with trenchant heels, trigonids high . . . . *Oödectes.*
  - CC. Lower molars with basin heels, trigonids low, m_2 and m_3 and heel of m_1 large . . . . *Vulpavus.*
  - CCC. Lower molars flat topped, premolars much reduced . . . . *Palæarctonyx.*

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[1] I take occasion to note that the expression "Cercoleptoid Miacidæ" does *not* involve any hypothesis that *Cercoleptes* is descended from this group, but merely that the teeth show a similar adaptation.

Didymictis *Cope* 1875.[1]

Type, D. protenus (COPE 1874) from Wasatch of New Mexico.

Syn., Viverravus WORTMAN (and MATTHEW) 1899, MATTHEW 1901, in part. Not *Viverravus* MARSH 1872.

Distinguished from *Viverravus* by the broader, basined heels of the lower molars; upper molars with metaconule and posterior crest of protocone well developed.

This genus is among the most abundant and best known of the Lower Eocene Creodonts, ranging from Torrejon to Lost Cabin, the species pro-

Fig. 12. *Didymictis*, upper teeth of *D. altidens* (Lost Cabin beds), *D. protenus* (Gray Bull beds) and *D. haydenianus* (Torrejon formation). All natural size, crown views.

gressively larger and more robust, with the tubercular and sectorial dentition more clearly differentiated in the later species, the jaw heavier and deeper.

The Torrejon *Didymictis, D. haydenianus,* differs materially from the later species, approaching *Viverravus* in the acute angulate form of the cusps, higher trigonid of m_2, and the compressed premolars, although it shows the basined heels of the molars which are the primary generic distinction.

[1] Syst. Cat. Vert. Eoc. New Mex., p. 5.

Key to Species of Didymictis.

A. M_2 with higher trigonid, imperfectly tubercular. Protocone of m^1 high angulate, with posterior wing weak. Two posterior accessory cusps on p_4, none on p_3.
   1. Length of p_1–m_2 = 33–38, of m_{1-2} = 14 mm. . . . . *D. haydenianus.*

AA. M_2 tubercular with low trigonid. Protocone of m^1 broader with anterior and posterior wings subequal. A posterior accessory cusp on p_3 and p_4.
   2*a*. Length of p_1–m_2 = 45–53 mm., m_{1-2} = 16–18 mm. . *D. protenus leptomylus.*
   2. Length of p_1–m_2 = 55–60 mm., m_{1-2} = 19–22 mm. . . . . *D. protenus.*
   2*b*. Length of p_1–m_2 = 65–70 mm., m_{1-2} = 21–24 mm. . . *D. protenus lysitensis.*
   3. Length of p_1–m_2 = 70–75 mm., m_{1-2} = 24–26 mm. . . . . *D. altidens.*

Didymictis protenus leptomylus *Cope* 1880.

Didymictis leptomylus Cope 1880, Amer. Nat., Vol. XIV, p. 908; 1885, Tertiary Vertebrata, p. 309, pl. xxva, fig. 12; pl. xxvd, fig. 6; Matthew 1901, Bull. A. M. N. H., Vol. XIV, p. 10.

Type, A. M. No. 4238, lower molars (m_1l., m_2r. & l) recorded as from the Wind River Basin, Wyoming, but more probably from Big Horn Basin.

Cope distinguished this species from *D. protenus* by the smaller size and more elongate m_2. In 1885 he referred to it, as a larger variety, a number of jaws from the Big Horn Basin intermediate in size between the type and *D. protenus.* Matthew in 1901 referred to this larger variety a number of upper and lower jaws and fragmentary skeletons from the lower levels of the Big Horn Wasatch, and pointed out certain additional distinctions in the teeth. Several specimens of upper and lower jaws obtained by the Museum parties of 1910–12 from the Clark Fork and Sand Coulée (red-banded beds) and lower levels of the Gray Bull, confirm these characters. All the specimens, however, except one, are larger than the type, and the intergradation with the typical *D. protenus* makes it appear that this is a primitive subspecies scarcely entitled to distinct specific rank.

Distinctive characters: p_1–m_2 = 45–53 mm., m_{1-2} = 16 mm. (type) to 18 mm. Parastyle of m^1 less extended.

Nos. 15856, 16071, lower jaws, and several unnumbered jaw fragments with upper and lower teeth from the Clark Fork beds are referable to *D. leptomylus;* Nos. 2806, 2855, upper and lower jaws with considerable parts of skeleton are from the lower beds of the Wasatch in the Big Horn Valley but their exact level is uncertain. Of the later collections, the specimens from the lower levels of the Gray Bull horizon are all of size approximating the above measurements; in the middle and upper levels the specimens are progressively larger and agree more nearly with *D. protenus.*

Didymictis protenus (*Cope* 1874).

Limnocyon protenus Cope 1874, Rep. Vert. Foss. New Mex., p. 15; (*Didymictis*) 1875, Syst. Cat. Vert. Eoc. New Mex., p. 11; 1877, Ext. Vert. New Mex., p. 123, pl. xxxix, figs. 1–9; 1885, Tertiary Vertebrata, p. 311, in part.

Syn. Didymictis curtidens Cope 1882, Pal. Bull. 34, Proc. Am. Phil. Soc., Vol. XX, p. 160; Tert. Vert. p. 313, pl. xxivd, fig. 10.

Type, U. S. Nat. Mus. No. 1092, lower jaws from the New Mexican Wasatch.

Distinctive characters: P_1–m_2 = 55–60 mm.; m_{1-2} = 19–22 mm. Parastyle of m^1 considerably extended, with oblique crest, no distinct metastyle on cingulum.

This is the typical and best known species of the genus, and is represented in our collections by a large series of specimens, including several skulls, with fragmentary skeletons, and numerous upper and lower jaws. The greater part are from the Big Horn Basin, but three lower jaws are from the New Mexican Wasatch, a number of parts of jaws from the Wind River and Clark Fork basins, and a single jaw fragment from the Evanston Wasatch.

The New Mexican specimens agree fairly well with the type; they represent both upper and lower horizons. The specimens from the Lysite level in the Big Horn and Wind River basins, are uniformly larger and are referred to a more progressive mutant. To this variety also belong a number of Big Horn specimens of earlier collections; their horizon is not exactly recorded, but from such records as exist of level and locality, and from the character of matrix and preservation, it appears that they are from the Lysite or the upper levels of the Gray Bull. Among these are the specimens figured by Cope in 1885 and Matthew in 1901. This larger variety (*D. protenus lysitensis* infra) is not recognized in the New Mexican Wasatch, but the Evanston specimen appears to be referable to it.

Didymictis curtidens was based upon a lower jaw fragment in which the space behind the carnassial for m_2 is less than normal; but this may be due to immaturity or to abnormal retardation of the eruption of m_2; it is not distinguishable otherwise from *protenus* and no other specimens confirm its supposed characters.

Didymictis protenus lysitensis mut. nov.

Didymictis protenus Cope 1885, Tert. Vert. p. 311, pl. xxvd, figs. 4 and 5; (*Viverravus*) Matthew 1901, Bull. A. M. N. H., Vol. XIV, p. 8, figs. 1–5.

Type, No. 15639 from Lysite of 15-mile Creek, Big Horn Basin, Wyoming.

Distinctive characters: p_1–m_2 = 65–70 mm.; m_{1-2} = 21–24 mm. Parastyle of m^1 much extended with oblique crest, sometimes double cusped; metastyle a more or less distinct cusp.

This is intermediate between *protenus* and *altidens.* All the specimens from the Lysite horizon in the Big Horn and Wind River basins conform to the above characterization. A number of specimens in the older collections also agree with it, and most if not all of them appear from the character of

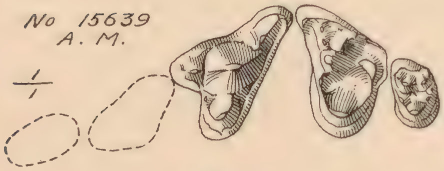

Fig. 13.

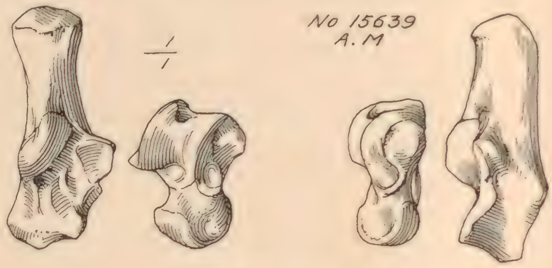

Fig. 15.

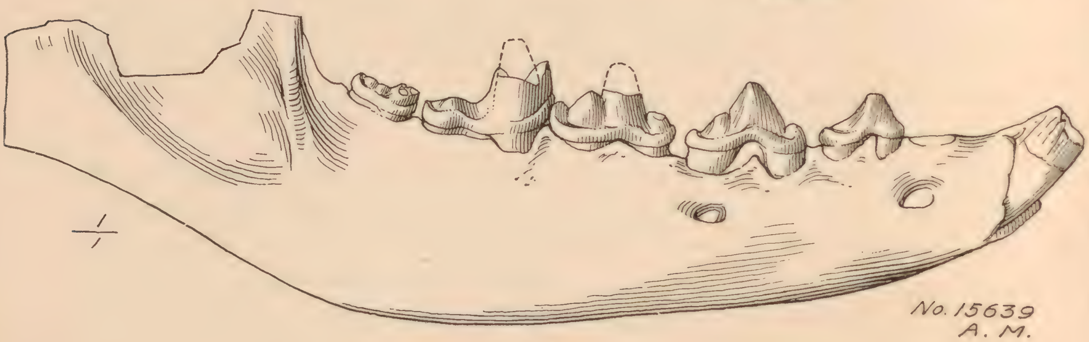

Fig. 14.

Fig. 13. *Didymictis protenus lysitensis.* Upper teeth of type skeleton, crown view, natural size left side, m^1 reversed from right side. Lysite beds, Big Horn Basin, Wyoming.

Fig. 14. *Didymictis protenus lysitensis*, lower jaw, outer view, natural size. From type specimen, fragmentary skeleton from Lysite beds of Big Horn Basin, Wyoming.

Fig. 15. *Didymictis protenus lysitensis*, calcaneum and astragalus of type specimen, natural size, superior and internal views.

the matrix or the records of locality to be from the Lysite or the upper levels of the Gray Bull. The New Mexican Wasatch has not yielded any specimens referable to this subspecies, although some are larger than the type of *D. protenus.*

Nos. 2831, 4230, 15640–3, 83, 4236, etc., are from the Big Horn Basin, 12812a, 12775 from the Wind River Lysite.

Didymictis altidens *Cope* 1880.[1]

Type, No. 4792, lower jaw fragments with m_1 and m_2, from the Wind River Basin, Wyoming.

This species is characteristic of the Lost Cabin horizon, from which Mr.

[1] Amer. Nat., Vol. XIV, p. 746.

Granger obtained a number of upper and lower jaws more or less fragmentary, affording between them a fairly complete reconstruction of upper and lower cheek teeth.

The distinctions from *D. protenus* are the larger and more robust teeth,

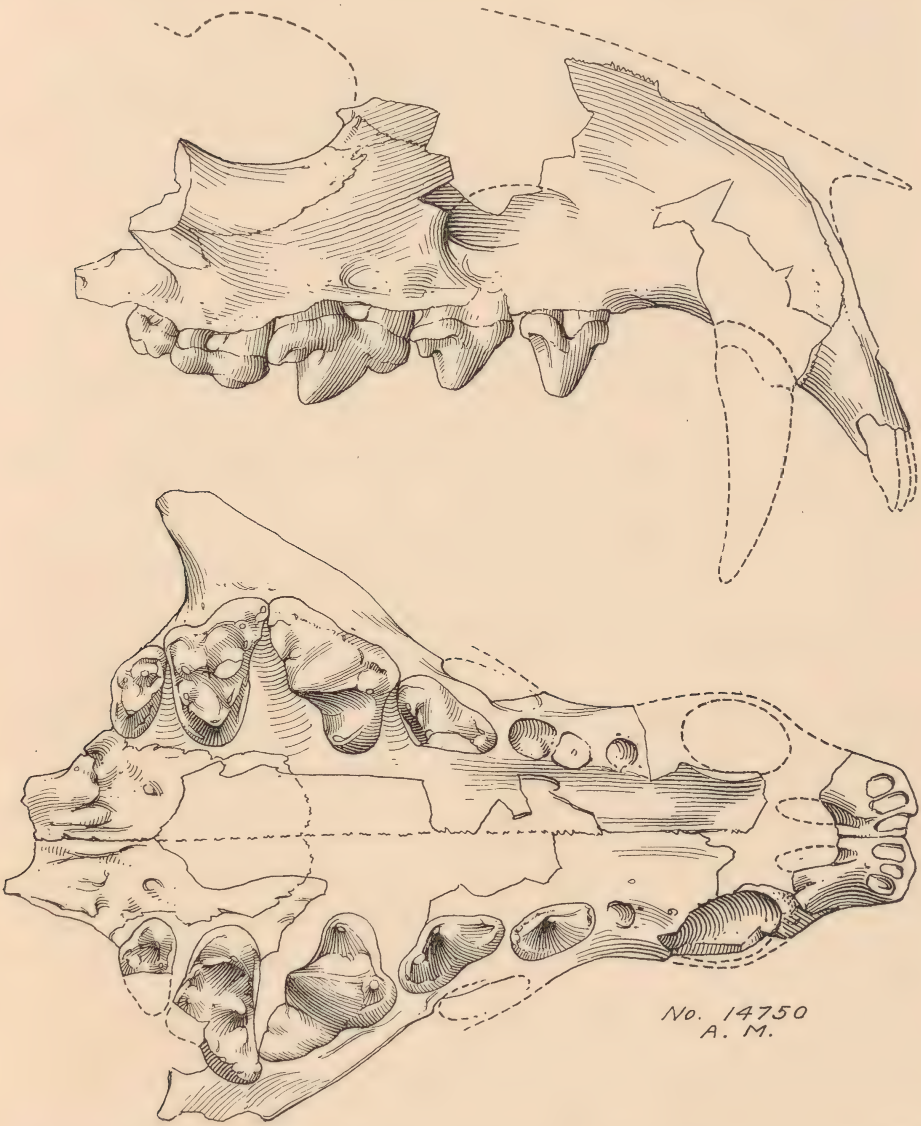

Fig. 16. *Didymictis altidens*, palate, natural size. No. 14750, Lost Cabin beds, Wind River Basin, Wyoming.

heavier protocone and deuterocone of p^4, discontinuous internal cingulum of m^1, m^2 more oval in outline, less extended transversely, with broader anteroexternal cingulum and more reduced metacone, lower premolars with more massive but less distinct posterior accessory cusps, hypoconid of m_1 larger and more massive and more central in position, filling up most of the "basin" of the heel, m_2 broader and with shorter heel. Jaw a little longer than in *D. protenus* but considerably deeper.

Nos. 14749–52 upper and lower jaws from the Lost Cabin horizon in the

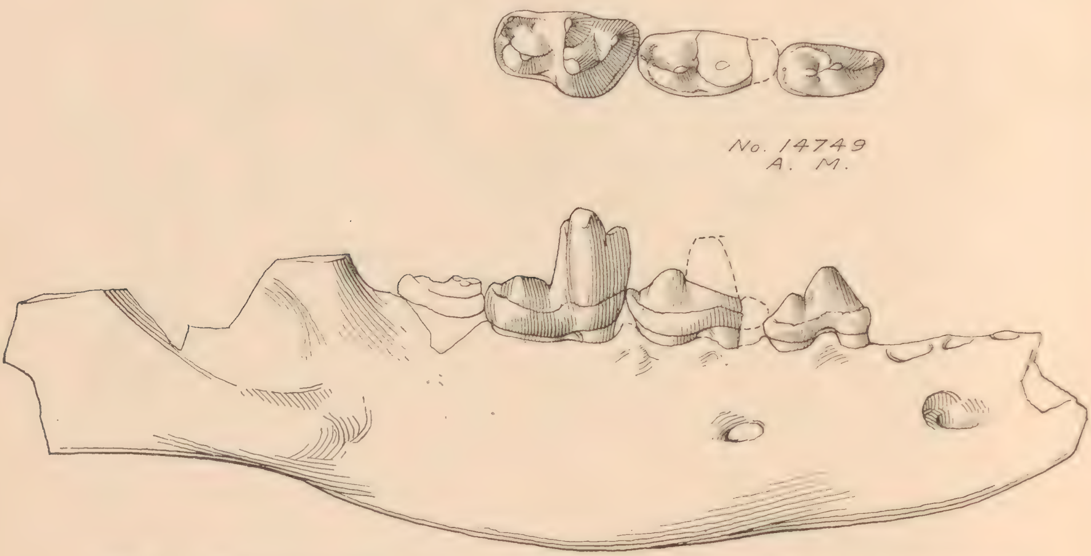

Fig. 17. *Didymictis altidens*, lower jaw, outer view, with crown view of teeth, natural size. No. 14749, Lost Cabin beds, Wind River Basin.

Wind River Basin, and 4792–8 fragments of jaws and teeth probably from the same level, are referable to this species. The specimens from the Lysite horizon are referable to *D. protenus*. In the Big Horn Basin a specimen has been described by Prof. Scott as *D. altidens*.[1] Information as to the exact locality of this specimen was kindly supplied by Professor Scott. It is from the westward extension of Tatman Mountain in the Big Horn Basin and was associated with *Lambdotherium*. Its horizon is thus fixed as Lost Cabin.

In No. 14750 the palate is very well preserved, and in No. 14749 the lower jaw.

I refer to this species No. 14781, a specimen from the Lost Cabin beds in the Wind River Basin, consisting of the tibiæ, fibulæ and complete hind feet, with a few other fragments. The reference is based upon agreement in construction of the foot bones with the corresponding parts in associated specimens of the smaller species.

[1] Scott, 1888, Jour. Acad. Nat. Sci. Phila., Vol. IX, p. 169.

The feet display the characters of Viverravinæ as outlined by Matthew in 1909. The ungual phalanges are long, not strongly curved or compressed as in the Miacinæ, but as in all Eucreodi they are unfissured at the tips. The symmetry of the pes is paraxonic, mt. III and IV paired. The hallux is not divergent as it is in *Vulpavus,* nor have the cuneiforms the curious oblique facets noticed in that genus; in this and other respects they are more like those of modern Carnivora. The astragalus has a considerable cuboid facet, a very oblique and shallow grooved trochlea, the outer crest more distinct than in Miacinæ. The forward movement of the tibia is limited by two well marked facets upon the neck of the astragalus; one for the internal malleolus upon its inner slope, the other for the anterior face of the tibia upon the outer slope of the neck, and continuous with the trochlea. The astragalar foramen limits the play of the tibia posteriorly so that the motion at this joint is not extensive. The movement of the fibula on the calcaneum is similarly limited. The patellar trochlea of the femur is very long, the patella small and flat, not elongate; the condyles of the femur face posteriorly. The fibula is unusually heavy; tibia and fibula moderately long. The proximal and second row of phalanges are of moderate depth and permit extended movement on the metapodials; the second phalanx is slightly asymmetric but not excavated for a retractile claw.

The unciform is broad and low, with a fairly wide lunar facet, whose angle with the cuneiform facet is very slight.

The construction of the pes in this genus differs very considerably from that in the Miacinæ, although it has the essential family features. It affords an interesting comparison with the pes of *Oxyæna* from the same formation.

Fig. 18. *Didymictis altidens,* tibia and fibula, natural size, anterior and distal views, No. 14781, Lost Cabin beds, Wind River Basin.

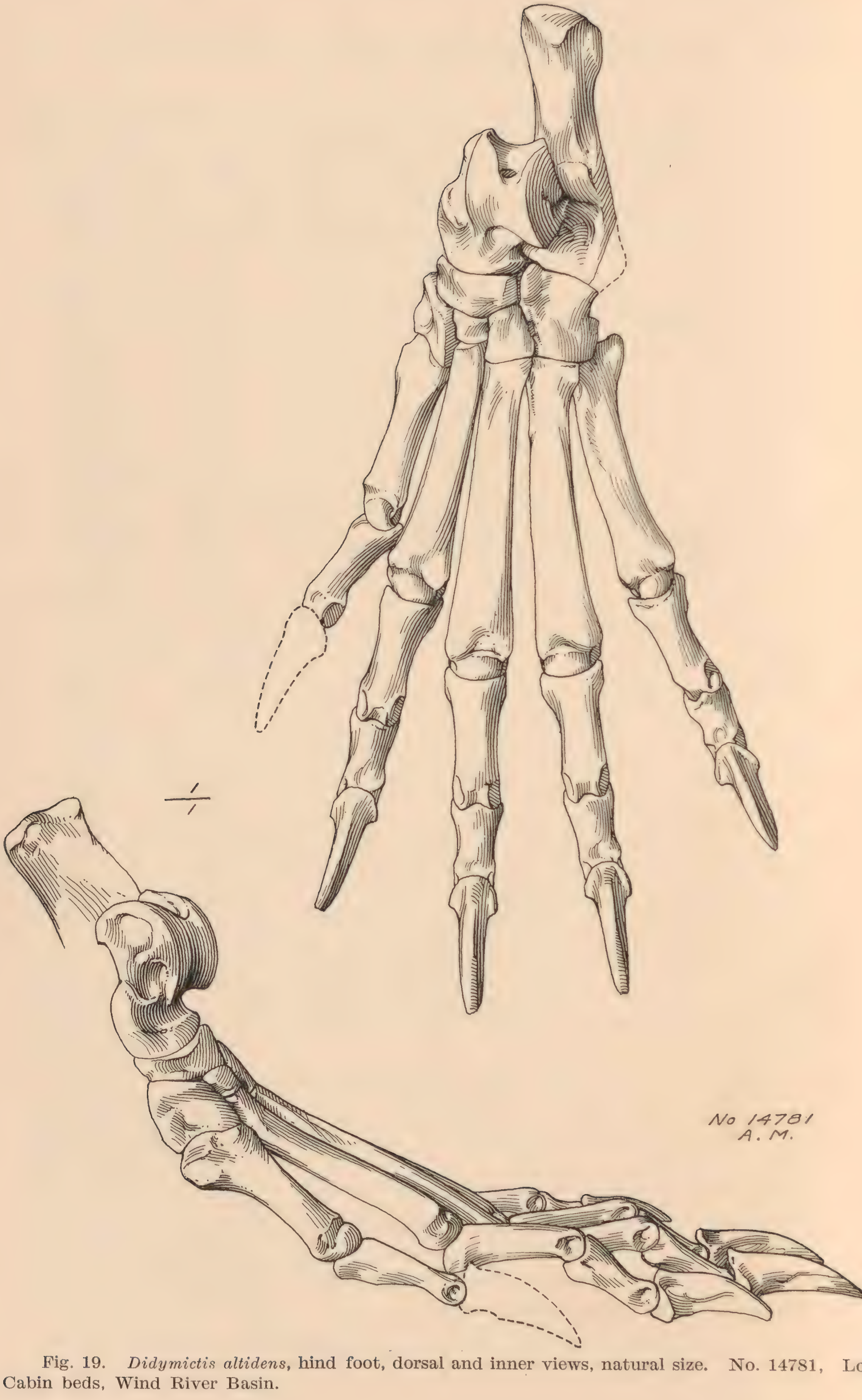

Fig. 19. *Didymictis altidens*, hind foot, dorsal and inner views, natural size. No. 14781, Lost Cabin beds, Wind River Basin.

Viverravus *Marsh* 1872.[1]

Type, *V. gracilis* from Lower Bridger of Wyoming.
Syn., *Didymictis* Cope, in part.

This genus is represented in the Lost Cabin and Lysite beds by *V. dawkinsianus* (Cope), in the Sand Coulée and Gray Bull by two undescribed species with premolars very like those of *Miacis*. The successive species from Sand Coulée to Bridger show a progressive elongation of the premolar region of the jaw and lengthening of the premolars. *V. dawkinsianus* is close to *gracilis;* the two older species are much more primitive. No notable change occurs in the molar teeth.

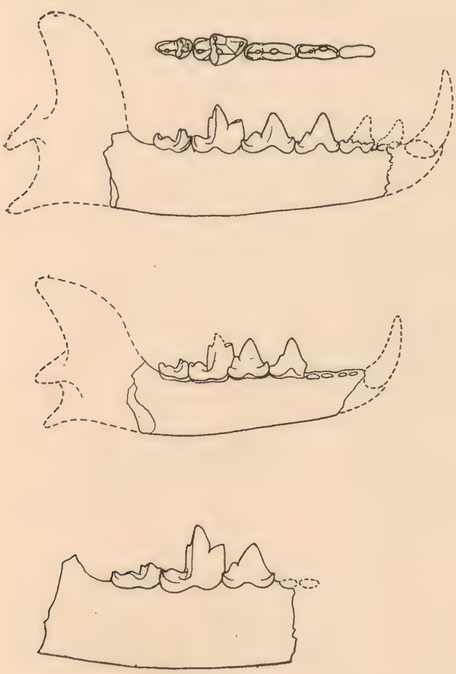

Fig. 20.

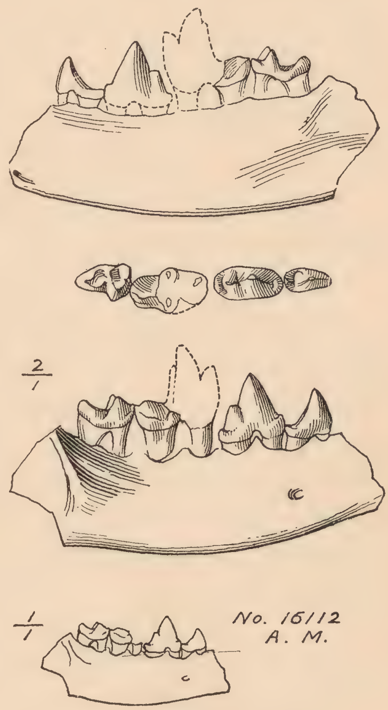

Fig. 21.

Fig. 20. *Viverravus*, lower jaws of three species of the Lower Eocene. Above, *V. dawkinsianus*, Lost Cabin zone, middle figure *V. acutus*, lower figure *V. politus*, both Sand Coulée and lower Gray Bull zone. All natural size.

Fig. 21. *Viverravus acutus*, lower jaw, inner and outer views and crown view of teeth, twice natural size, with outline of natural size. Type specimen, Sand Coulée beds, Clark Fork Basin.

Viverravus acutus sp. nov.

Type, A. M. No. 16112, parts of lower jaws and fragments of upper jaws from Sand Coulée beds, Clark Fork, Wyoming.

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[1] Amer. Jour. Sci., Vol. IV, p. 127.

Distinctive characters: Premolars high, short, compressed, like those of Miacinæ. A small posterior accessory cusp on p_4, none on p_3. m_{1-2} 7.5 mm.

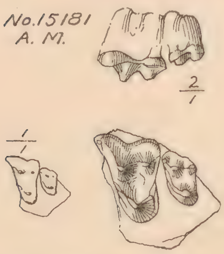

Fig. 22. *Viverravus acutus*, upper jaw fragment with molar teeth, enlarged to two diameters, and outline of natural size. No. 15181, Gray Bull beds, Big Horn Basin.

This species is smaller than *V. dawkinsianus* and readily distinguished by the proportions of the premolars, very different from the elongate teeth of all other Viverravinæ and resembling those of *Miacis*. The molar teeth are reduced copies of *dawkinsianus*. Five lower jaws Nos. 15174, 15181, from the Gray Bull beds and Nos. 89, 90 and 4247 from the Big Horn basin, probably Gray Bull beds, are referable to this species but all somewhat more progressive in the direction of *V. dawkinsianus*.

Viverravus politus sp. nov.

Type, No. 16113, lower jaws with m_{1-2}r, p_4–m_2l., from Sand Coulée beds in Clark Fork Basin, Wyoming.

Distinctive characters: Premolars short and high, as in *Miacis;* $m_{1-2} = 12.5$ mm.

This species, like *V. acutus*, retains the short high premolars of *Miacis*, but is a much larger animal, intermediate in size between *V. gracilis* and *V. sicarius*.

No. 15180, comprising parts of both rami of the lower jaw from the Gray Bull Beds, Big Horn Basin, is referred to this species but is somewhat larger and more robust than the type.

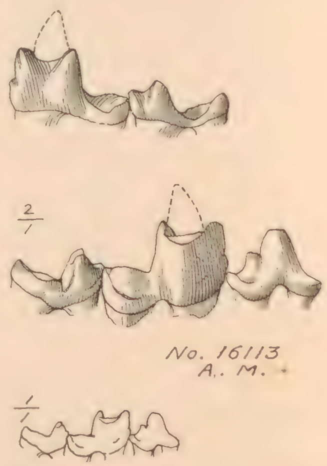

Fig. 23. *Viverravus politus*, lower teeth inner and outer views enlarged to two diameters, and outline of natural size. Type specimen, No. 16113, Sand Coulée beds, Clark Fork Basin.

Viverravus dawkinsianus (*Cope* 1881).

Didymictis dawkinsianus Cope, 1881, Bull. U. S. G. S. Terrs., Vol. VI, p. 191; 1885, Tertiary Vertebrata, p. 310, pl. xxva, fig. 11; (*Viverravus*) Wortman, 1899, Bull. A. M. N. H., Vol. XII, p. 136.

Type, No. 4788, lower jaw from the Lost Cabin horizon of the Wind River Basin, Wyoming.

Distinctive characters: Premolars long, compressed, not high, prominent posterior accessory cusps on p_3 and p_4. Length of p_{1-4} less than twice m_{1-2}; p_1–m_2 (approximately) $= 27.5$; $m_{1-2} = 10$ mm.

This species is closely allied to *V. gracilis*. I can find no evidence for Cope's statement that p_1 has but one root, but the premolar portion of the jaw is shorter than in *V. gracilis* (in which $p_1 - m_2 = 30$ mm.; $m_{1-2} = 9.5$ mm.). It is thus intermediate between *V. acutus* and *gracilis*, but nearer to the latter. Six lower jaws, all from the Lost Cabin horizon in the Wind River Basin, are referable here.

Uintacyon *Leidy* 1871.

Type, U. edax from Middle Eocene (Bridger).

Generic characters: Dentition $\frac{?3.1.4.?3}{?3.1.4.\ 3}$; p^4 carnassiform with small parastyle; m^{1-2} with moderately extended parastyles, metacones slightly smaller than paracones, protocones lacking posterior crest. Lower premolars reduced, posterior accessory cusps rudimentary; m_1 with high trigonid and trenchant heel, m_2 short with low trigonid and small trenchant heel.

Two distinct species are represented in our Lower Eocene collections. One, "*Didymictis*" *massetericus* Cope is about the size of the Bridger species

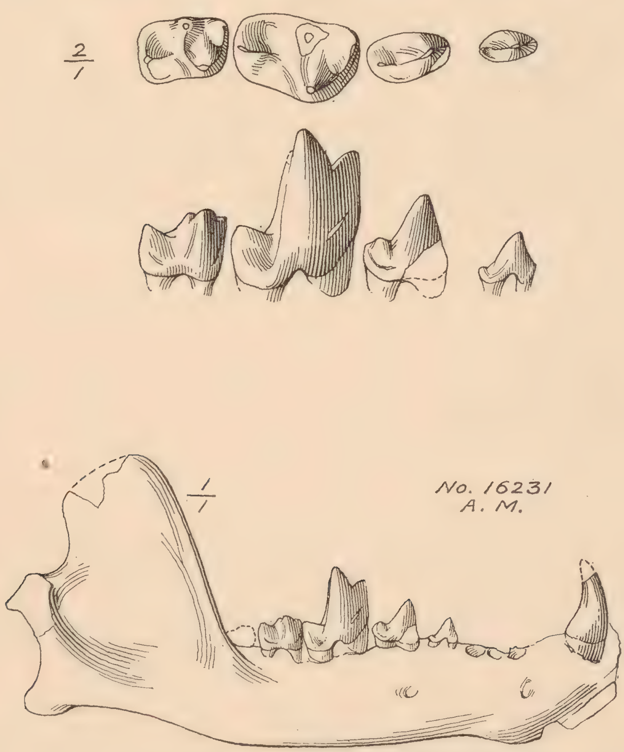

Fig. 24. *Uintacyon massetericus*, lower jaw, outer view, natural size, and crown and outer views of teeth enlarged to two diameters. No. 16231, Almagre beds, Wasatch formation, San Juan Basin, New Mexico.

U. jugulans. The other is about as large as *U. vorax* Leidy. Both are rare. The genus is differentiated from *Miacis* by the trenchant heels of its lower molars and lack of a posterior crest of the protocone on upper molars. From *Viverravus* it is distinguished by the reduced premolars, short molars and retention of m_3. It occupies therefore an intermediate position between these two genera.

Uintacyon massetericus (*Cope* 1882).

Didymictis massetericus Cope 1882, Proc. Am. Phil. Soc. Vol. XX, p. 160; 1885, Tertiary Vertebrata, p. 312, pl. xxive, fig. 11; (*Uintacyon*) Matthew, 1909, U. S. G. S. Bull. 361, p. 93.

Type, No. 4250, lower jaw with p_4–m_2 l., from the Wasatch of the Big Horn Basin, probably Lysite or upper Gray Bull.

Specific characters: $p_{1-4} = 17.5$; $m_{1-3} = 14$. Heels of lower molars shorter and wider than *U. jugulans*, posterior accessory cusp of p_4 much smaller.

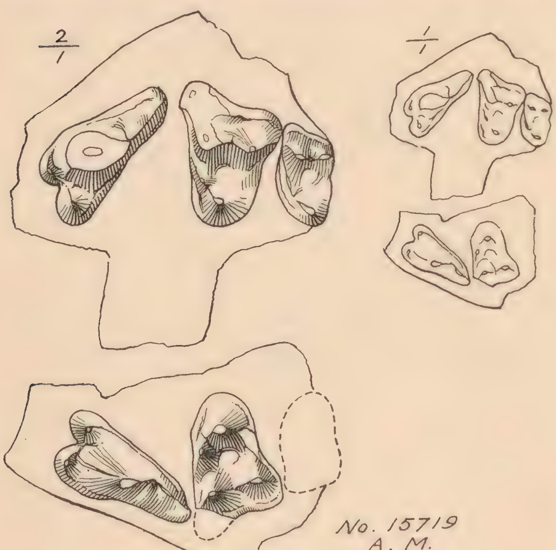

Fig. 25.

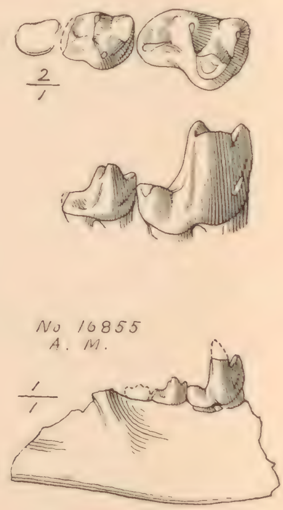

Fig. 26.

Fig. 25. *Uintacyon massetericus*, upper jaw fragments with p^4–m^2 left and p^4–m^1 of right side, enlarged to two diameters, with outline of natural size. No. 15719, lower Gray Bull beds, Big Horn Basin.

Fig. 26. *Uintacyon massetericus rudis.* Type specimen, lower jaw fragment, natural size, outer view, and outer and crown views of teeth, twice natural size. Sand Coulée beds, Clark Fork Basin.

In addition to the type I refer to this species two lower jaw fragments Nos. 15647 from the Lysite of the Big Horn Basin, No. 16749 from the upper Gray Bull beds, Big Horn Basin, and also No. 15719, upper jaw fragments from the Gray Bull horizon of the Big Horn. A nearly complete lower jaw, No. 16231, from the lower beds of the Wasatch of New Mexico also agrees quite closely with the type.

The species is near to *U. jugulans*, but the jaw is deeper, the premolar region more reduced, the molars shorter. The upper jaw shows p^4–m^2 in good preservation. P^4 has the inner cusp comparatively small and anterior in position, and the anteroexternal cusp is stronger than in other species, approaching *Viverravus.* The molars also approach *Viverravus* in construction, the protocone lacking the posterior wing, while the anterior wing is high and nearly continuous with the strong protoconule as a very marked transverse crest. Unlike *Viverravus* the paracone and metacone are of nearly equal size, and parastyle only moderately extended. The second molar has very little parastyle, the external shelf is rather narrow and is practically absent outside the metacone. Presence of m^3 is not demonstrated.

Uintacyon massetericus rudis mut. nov.

Type, No. 16855, a lower jaw fragment from Sand Coulée horizon in Clark Fork Basin.

Distinctive characters: M_2 smaller than in the type, the trigonid more distinct from talonid and higher; talonid smaller.

This is a primitive stage of Cope's species with the carnassial and tubercular dentition less sharply differentiated. Nos. 16750 and 16751, from the Systemodon zone are intermediate between this and typical *massetericus.*

Measurements.

	Type, No. 4250	No. 16231, New Mex.	No. 15719, Gray Bull	No. 16750, Gray Bull	No. 15647, Lysite
Total length of jaw, canine to condyles	67				
Lower premolars, p_{1-4}	17.5				
Lower molars, m_{1-3}	13.8				
Upper teeth, p^4–m^2			16.6		
P^4 anteroposterior diameter			8.5		
" transverse "			5.0		
M^1 anteroposterior "			5.5		
" transverse "			8.0		
M^2 anteroposterior "			3.1		
" transverse "			5.9		

Measurements.— (Continued.)

	Type, No. 4250	No. 16231, New Mex.	No. 15719, Gray Bull.	No. 16750, Gray Bull.	No. 15647, Lysite
P_3, anteroposterior diameter					
" height of crown					
P_4 anteroposterior diameter	6.1				5.3
" height of crown	4.9				4.4
M_1 anteroposterior diameter	6.9			7.0	7.3
" transverse " of trigonid	4.7			4.1	
" height of protocone from base of enamel	6.9			6.2	
" anteroposterior length of heel	2.5			2.5	
M_2 anteroposterior diameter	4.0			4.5	4.6
" transverse "	3.6			3.2	3.8

Uintacyon *cf.* **vorax.**

A larger species is represented by No. 15748, two lower jaw fragments of one individual from the Gray Bull beds of Shoshone River in the Big Horn Basin. It is very probably distinct from the Middle Eocene species with which I have compared it, but the specimen does not show any clearly distinctive characters.

Measurements.

P_4–m_3	26.5
M_1 diameters, a–p × tr	8.4 × 5.7
M_2 " " "	6.0 × 4.2
Heel of m_1 diameters a–p by tr	3.3 × 4.7
Depth of jaw beneath m_1	17.1

Miacis *Cope* 1872.[1]

Type, *M. parvivorus* from the Lower Bridger of Wyoming.

To this genus may be referred two species from the Lower Eocene. The differentiation of the carnassial dentition is a little less advanced than in

[1] Pal. Bull. No. 3, Aug. 7, 1872; Proc. Am. Phil. Soc., Vol. XII, p. 470.

M. parvivorus of the Lower Bridger, considerably less than in the later species of the genus, but more than in the Lower Eocene species hereafter

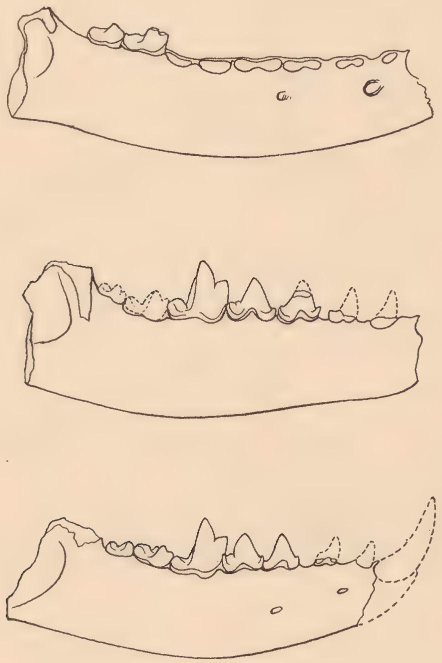

Fig. 27. *Miacis*, lower jaws of two Lower Eocene species. Above, *M. latidens* type, Lost Cabin beds, below, *M. exiguus*, No. 15717, Upper Gray Bull beds; intermediate *M. latidens* mut. prim., No. 15177, Lower Gray Bull beds. All natural size.

referred to *Vulpavus* and decidedly more than in the Middle Eocene typical species of *Vulpavus*.

Miacis exiguus sp. nov.

Type, No. 15176, palate, part of lower jaw and fragmentary skeleton; paratypes Nos. 15717, 15718, lower jaws, all from the Gray Bull beds, Big Horn Basin, Wyoming.

Distinctive characters: P_1–m_3 = 38 mm.; m_{1-3} = 13. P^4 and m_1 carnassiform, parastyles of m^{1-2} extended, upper molars with cingulum continuous around protocone, heavier posteriorly but not forming a hypocone. Parastyle of p^4 minute. M_1 with high trigonid and basin heel; m_2 with low trigonid but not completely tubercular; m_3 tubercular, oval with trigonid cusps distinct, small basin heel and roots imperfectly separate. Premolars rather short, high, compressed with minute anterior and posterior basal cusps, and a small posterior accessory cusp on p_4. P_1 one-rooted; p_2 spaced.

This is the smallest of the Lower Eocene Miacidæ except *Viverravus acutus* and *dawkinsianus*. Fragments of the skeleton associated with the type show that the animal was a little larger than *M. parvivorus* although the jaws are of the same size or slightly smaller. The vertebral centra (caudals

Fig. 28. *Miacis exiguus*, palate, twice natural size, with outline of actual size. Type specimen (fragmentary skeleton), Gray Bull beds, Big Horn Basin.

and lumbars) are more robust, the limb bones heavier, but their length cannot be determined.

Fifteen lower jaws from the Gray Bull horizon of the Big Horn Wasatch are referable to this species.

Miacis latidens sp. nov.

Type, No. 14766, lower jaw and part of maxilla, with m_{2-3} and m^{1-2}, from the Lost Cabin beds of the Wind River Basin.

Distinctive characters: P_1–m_3 = 35 mm., m_{1-3} = 16 mm. Upper molars with parastyle moderately extended, paracone much larger than metacone, narrow cingulum around protocone, no hypocone; m^2 decidedly smaller than m^1, m^3 minute. Lower molars with trigonid larger than heel, m_3 two-rooted, much smaller than m_2; heels basined, trigonids low. Premolars rather small, spaced, p_1 one-rooted. Canine moderately large, not compressed.

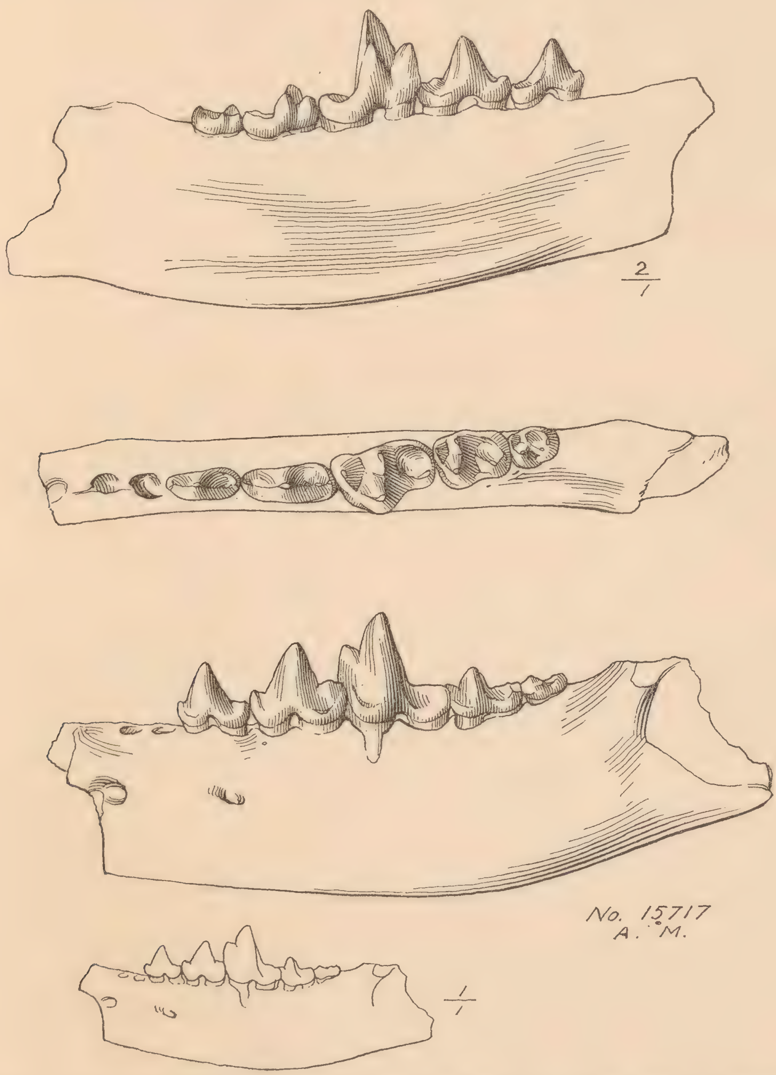

Fig. 29. *Miacis exiguus*, lower jaw, inner, occlusal and outer views, enlarged to two diameters, with outline of natural size. No. 15717, upper Gray Bull beds, Big Horn Basin. The heel of m_3 is badly preserved in this specimen, and has been interpreted from No. 15718.

This species is of the size of *Vulpavus australis* but the construction of the molars agrees with *Miacis*. It is perhaps a descendant of *M. exiguus*. It is a little larger than *M. parvivorus* of the Bridger, the tubercular dentition is relatively larger, and the upper molars broader. Only the type specimen is known from the Wind River, Nos. 15177–8 from the Gray Bull may be a primitive mutant of this species. The second molar in this mutant is somewhat larger and more like the first in pattern.

Other species of *Miacis* are represented by fragmentary specimens from the Big Horn Basin and the New Mexican Wasatch, but they are inadequate for specific types.

Fig. 30. *Miacis latidens*, upper and lower jaw with molar teeth, m^{1-2}, m_{2-3}, enlarged to two diameters, with outline of natural size. Type specimen, Lost Cabin beds, Wind River Basin.

Vulpavus *Marsh* 1871.[1]

Type, V. palustris, from the Lower Bridger of Wyoming.

Two Lower Eocene species are referable to this genus. As compared

[1] Amer. Journ. Sci., Vol. II, p. 124.

with the Middle Eocene species they retain considerably more of the tuberculo-sectorial character of the molars. This is most marked in the speci-

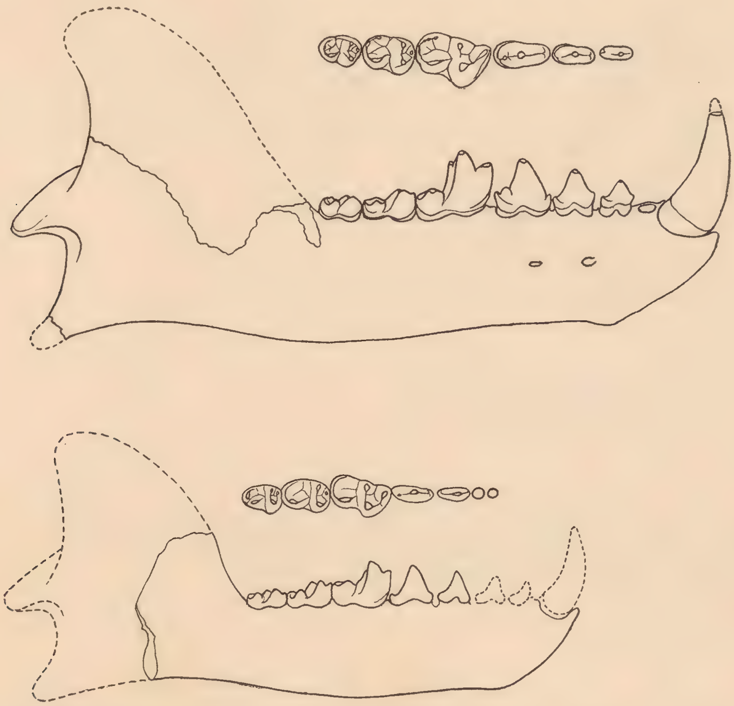

Fig. 31. Lower Eocene species of *Vulpavus*, lower jaws, natural size. Above, *V. canavus*, Nos. 14760 and 14767, Lost Cabin beds, Wind River basin; below *V. australis*, No. 16226 and 16227, Largo beds, San Juan Basin.

mens from the Gray Bull horizon; in the Lysite and Lost Cabin specimens it progressively disappears.

Vulpavus canavus (*Cope* 1881).

Miacis canavus Cope, 1881, Bull. U. S. G. S. Terrs. Vol. VI, p. 189; 1885, Tertiary Vertebrata, p. 302; *Uintacyon* Wortman, 1899, Bull. A. M. N. H., Vol. XII, p. 112; (*Prodaphænus*) Wortman 1901, Am. Jour. Sci., Vol. XI, p. 30; (*Vulpavus*) Matthew 1909, Mem. A. M. N. H., Vol. VI, p. 380.

Miacis brevirostris Cope, 1881, *l. c.*, p. 190; 1885, *l. c.*, p. 303; Wortman, 1899, *l. c.*

Type, Am. Mus. No. 4783, a lower jaw with teeth broken off, from Lost Cabin beds of Wind River Basin.

Type of *M. brevirostris*, Am. Mus. No. 4785, a lower jaw with m_2 and part of p_4, other teeth broken off, from same horizon and locality.

Distinctive characters: M_{1-3} = 19–20 mm., p_1–m_3 = 36–41 mm. Lower tubercular molars large; m_1 imperfectly carnassiform; m_3 two-rooted; heels of m_{1-2} as wide and as long as trigonids. Premolars reduced and spaced, slight accessory cusp on p_4. Jaw short, deep and heavy, canine large, not compressed.

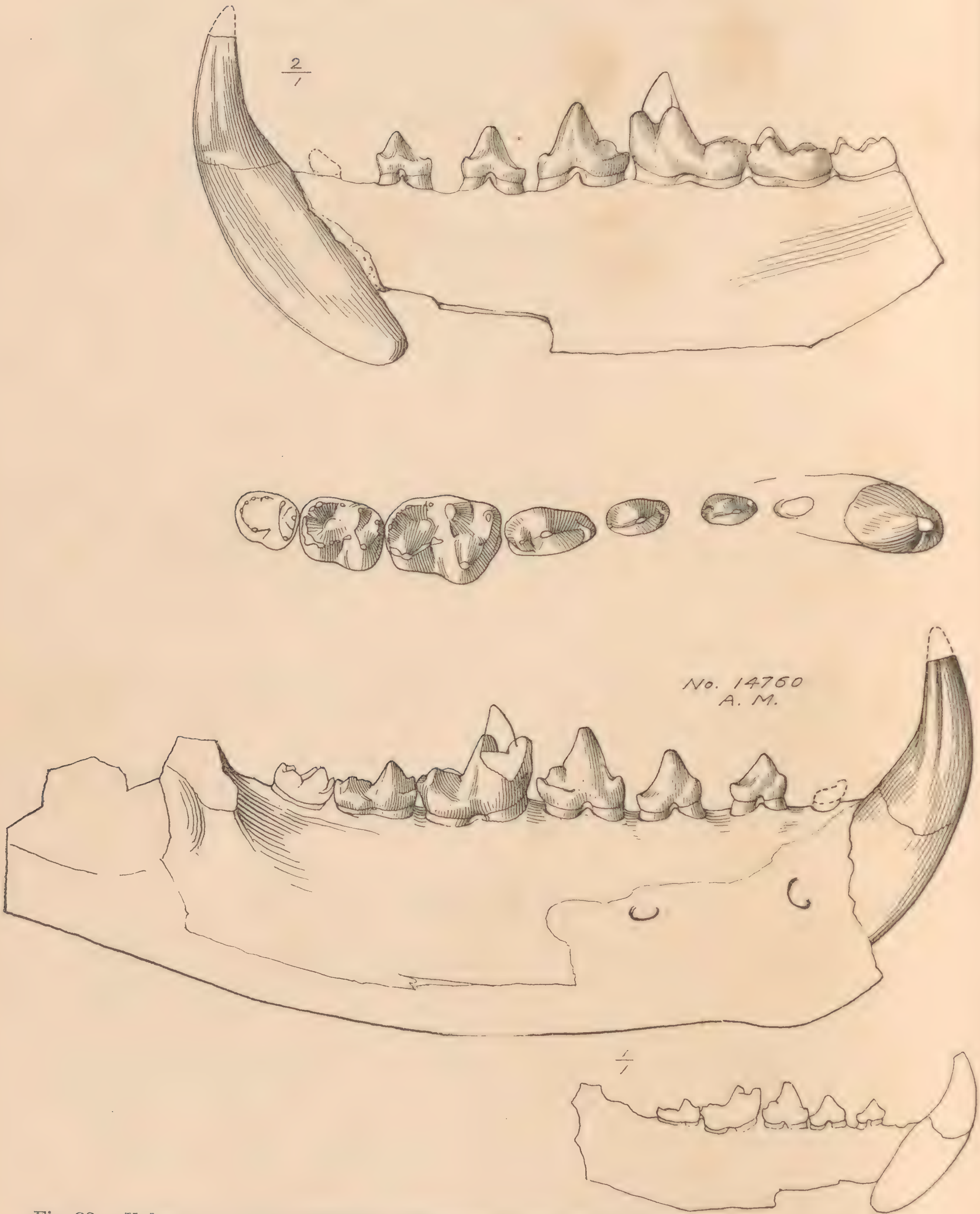

Fig. 32. *Vulpavus canavus*, lower jaw, internal and external, and crown view of teeth, enlarged to two diameters, with outline of natural size. No. 14760; outline of lower jaw and m_3 from No. 14763; tip of m_1 from No. 14761. Lost Cabin beds, Wind River Basin.

Ten lower jaws from the Lost Cabin horizon of the Wind River agree very well with the types of *canavus* and *brevirostris*, which differ only in very trifling or inconstant characters. Five jaw fragments from the Lysite vary a little in innumerable details towards *Miacis;* and in five specimens from the Gray Bull horizon, these differences are more pronounced, the trigonid of m_1 being higher, the heels of m_1 and m_2 narrower, the roots of m_3 imperfectly separated, the premolars relatively larger. Although insufficient in degree to warrant a specific separation, these differences are significant in confirming the approach of these two Miacid genera as we trace them back through the Eocene. Differences of similar kind and equal degree are seen in specimens of the following species from the three horizons.

Vulpavus australis sp. nov.

Type, No. 16226, lower jaw with p_4–m_3 from the Wasatch of New Mexico, ?lower beds.

Distinctive characters: Smaller than *V. canavus*, $m_{1-3} = 15$ mm.; canines less robust, teeth less massive, but very similar in constructive details.

Four specimens from New Mexico, two from the Lost Cabin beds of Wyoming, five from the Lysite and four from the Gray Bull beds, are referred to this species. Those from the Gray Bull beds show a distinct approach toward *Miacis*, as in *V. canavus*, but the New Mexican specimens, Nos. 16225–7, 16229, which except the type are all from the upper beds, agree nearly with the Lysite specimens. Nos. 14764–5 from the Lost Cabin are somewhat more progressive towards the typical *Vulpavus* from the Middle Eocene.

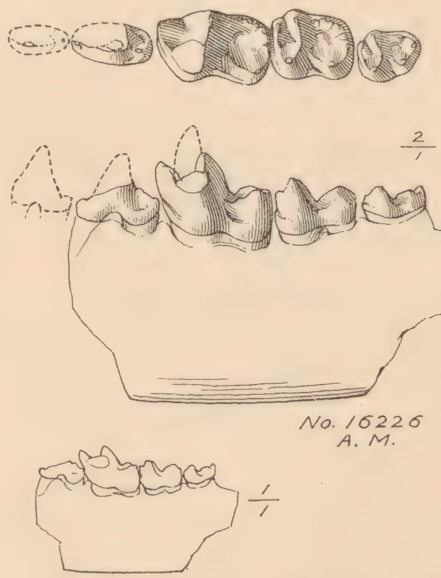

Fig. 33. *Vulpavus australis*, lower jaw, outer view and crown view of teeth enlarged to two diameters, with outline of natural size. Type specimen, Wasatch of San Juan Basin, New Mexico. Dotted outlines restored from No. 16227.

Vassacyon *Matthew* 1909.[1]

Type, *V. promicrodon* from the Wasatch of the Big Horn Basin.

This genus is in many respects intermediate between *Miacis* and *Vul-*

[1] U. S. G. S. Bull. 361, p. 93.

pavus, but has some peculiarities of its own. The principal characters of the skull and skeleton are known from specimens secured by Mr. Granger in the Big Horn Basin, and may be compared with *Vulpavus* and *Miacis* as described by Matthew in 1909.

The skull is proportioned as in *Vulpavus*, very much shorter than in the Viverravinæ, the basicranial region broad and long, the glenoid articulations set well forward of the occipital condyles. The detailed construction of this region is obscured by matrix but appears to be much as in *Vulpavus*. Occiput broad and low; sagittal crest moderately developed. Nasals somewhat broader posteriorly than in *Vulpavus*; premaxillæ more reduced. Facial exposure of lachrymal as in *Miacis* and *Vulpavus*.

Upper molars with short extension of parastyle, well developed hypo-

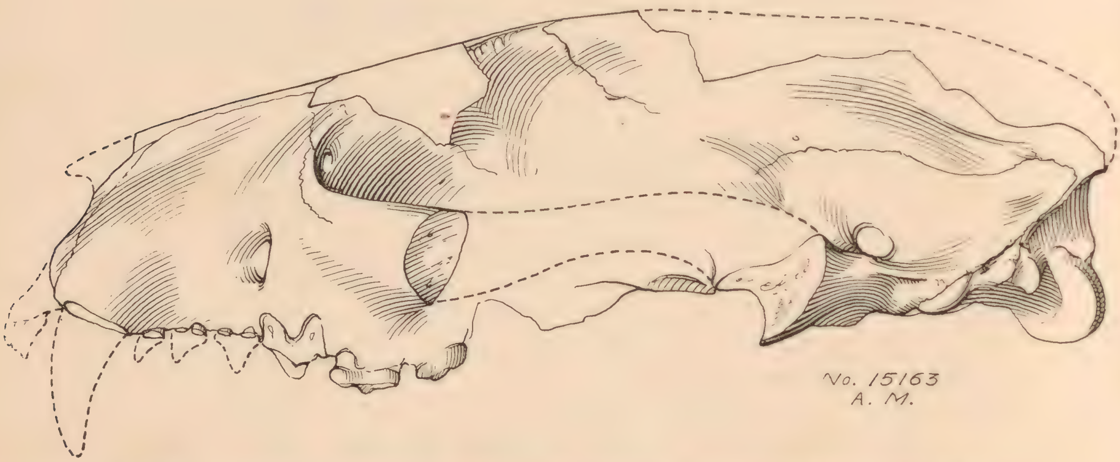

Fig. 34. *Vassacyon promicrodon*, skull, natural size. No. 15163, lower Gray Bull beds, Big Horn Basin.

cone, paracone somewhat larger than metacone; m^1 considerably larger than m^2; m^3 two-rooted. P^4 carnassiform. Anterior premolars reduced; p^2 and p^3 two rooted with small or rudimentary heelcusps; p^1 one-rooted. In the lower jaw m_1 is carnassiform with large basin heel; m_2 tubercular, large, with low trenchant heel; m_3 small, one-rooted, oval, tubercular cusps obscured. Premolars reduced, spaced; canine large, flattened, jaw below it angulate.

Skeleton much as in *Vulpavus*. Scaphoid, lunar and centrale united to a single bone. Trapezium larger than in any later Miacidæ. Claws compressed, high and sharp, not fissured at the tip.

Vassacyon promicrodon (*Wortman* 1899).

Uintacyon promicrodon Wortman (& Matthew) 1899, Bull. A. M. N. H., Vol. XII, p. 111; (Prodaphænus) Wortman 1901, Amer. Journ. Sci., Vol. XI, p. 30; (Vassacyon) Matthew 1909, U. S. G. S. Bull., 361, p. 93; Mem. A. M. N. H., Vol. VI, p. 376, pl. xliii, fig. 4.

Type, Am. Mus. No. 81, a lower jaw with p_4–m_1 from the Wasatch of the Big Horn Basin, probably Systemodon zone.

Distinctive characters: P_1–m_3 = 40; m_{1-3} = 19. Other characters given under the genus.

To this species are referred Nos. 15163, skull; 15161 parts of skull and jaws with a large part of the skeleton; 15160 skull, lower jaws and several limb bones; 15162, 15164, etc., lower jaws. All are from the Systemodon zone of the Gray Bull in the Big Horn Basin.

No. 84, a fragment of lower jaw with m_3 and the heel of m_2 was considered by Wortman a possible successor of this species in the Wind River (Lost Cabin zone). It is otherwise unknown from any later horizon.

This species is readily recognizable by the peculiar thickening of the lower border of the jaw externally along the symphyseal region. This is associated with a flattened lower canine, and a somewhat triangular but curved upper canine.

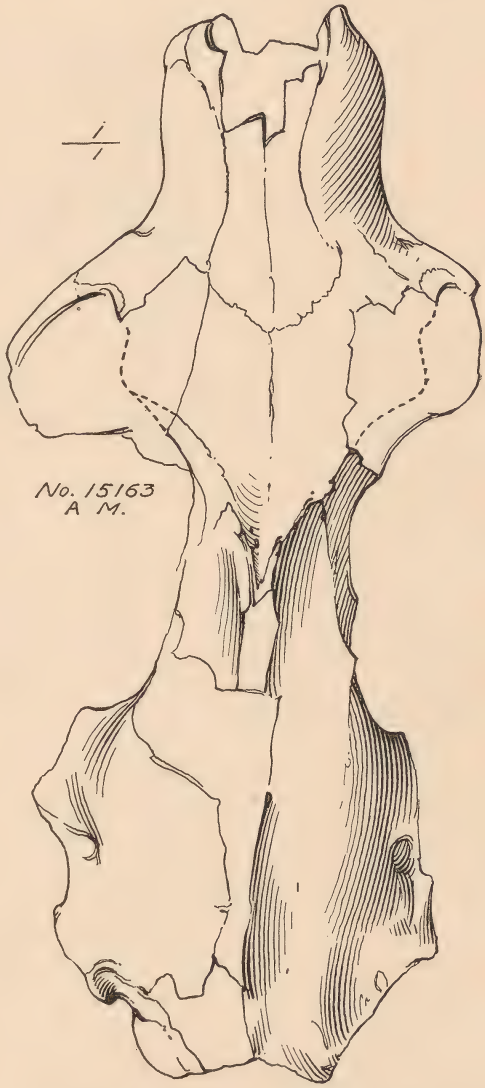

Fig. 35. *Vassacyon promicrodon*, skull, top view, natural size. No. 15163, Gray Bull beds, Big Horn Basin.

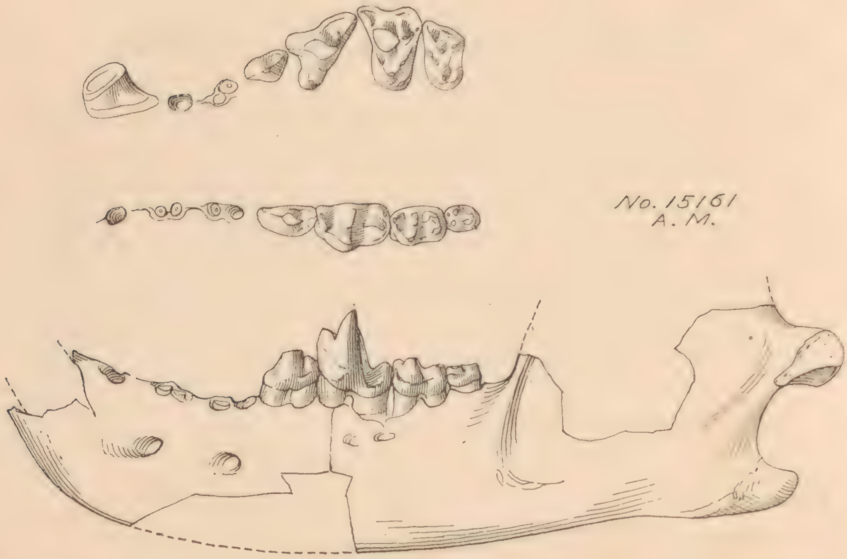

Fig. 36. *Vassacyon promicrodon*, external view of lower jaw and crown views of upper and lower teeth, natural size; from skeleton No. 15161, lower Gray Bull beds of Big Horn Basin.

OXYÆNIDÆ.

Family characters:[1] Carnassials $m\frac{1}{2}$, third molar absent.[2] Skull robust, basicranial region wide, jaws stout with strong symphysis. Lumbar zygapophyses cylindrical or revolute. No supratrochlear foramen on humerus. Manus and pes mesaxonic, claws fissured at the tip.

The Lower Eocene representatives of this family belong to three groups, (1) *Oxyæna*, large, predaceous types with powerful shearing molars; (2) *Palæonictis* and *Ambloctonus*, large, short faced types with robust teeth adapted for breaking (? bone-breaking) and shearing; (3) *Dipsalidictis* and *Prolimnocyon*, smaller and more primitive genera with tuberculosectorial molars. These three groups correspond in adaptation to the Felidæ, Hyænidæ and Viverridæ among modern carnivora.

Oxyæna is well known from the descriptions of Cope and Wortman, and while fairly abundant in the Lower Eocene the new material adds little to the morphology. *Palæonictis* and *Ambloctonus* are much scarcer, and of their skeletal construction very little is known. The new genus *Dipsalidictis* from the Clark Fork has the very primitive dentition of *Limnocyon* but lacks the progressive characters of the feet of that Middle and Upper Eocene genus, the feet being the most primitive known among Oxyænidæ.

[1] Matthew, 1909, Am. Mus. Mem., IX, 327.
[2] Except in *Prolimnocyon* infra.

Another new genus *Prolimnocyon* is structurally ancestral in dentition to *Limnocyon* and *Thinocyon* and is represented by a skull and several jaws from the Gray Bull horizon of the Wasatch. Its dental formula is that of

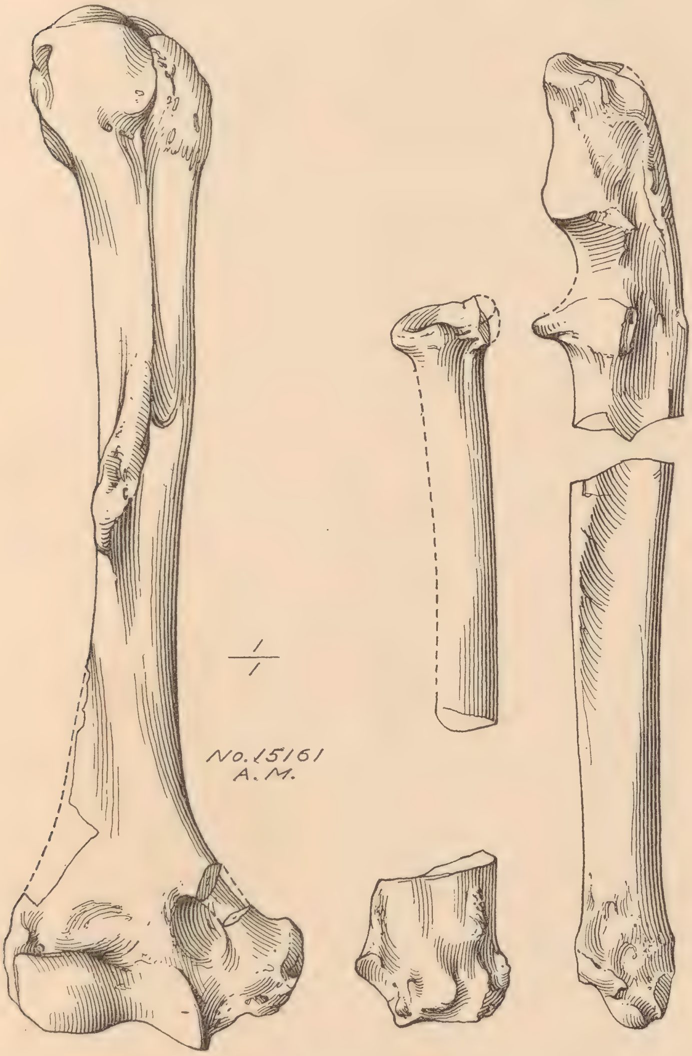

Fig. 37.

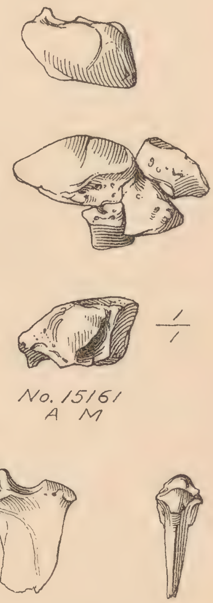

Fig. 38.

Fig. 37. *Vassacyon promicrodon*, humerus, radius and ulna, front views; from the skeleton No. 15161, Gray Bull beds, Big Horn Basin.

Fig. 38. *Vassacyon promicrodon*, carpal bones and ungual phalanx, natural size; above, scapholunar proximal view, dorsal view with magnum, unciform and cuneiform, distal view; below, ungual phalanx lateral and superior views. From skeleton No. 15161.

the early Hyænodonts, but it is typically Oxyænid in other respects, and indicates the approximation of these two families in the early Eocene.

The reference of *Ambloctonus* and *Palæonictis* to the Oxyænidæ (Mat-

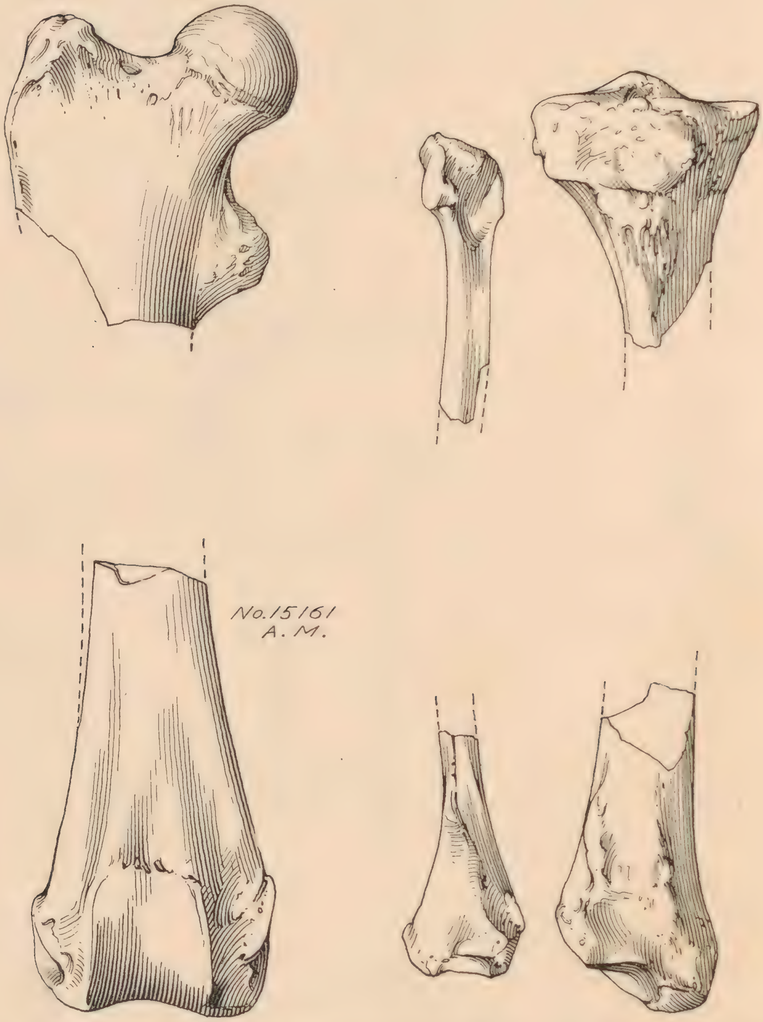

Fig. 39. *Vassacyon promicrodon*, hind limb bones, front views, natural size. From skeleton, No. 15161, Lower Gray Bull beds, Big Horn Basin.

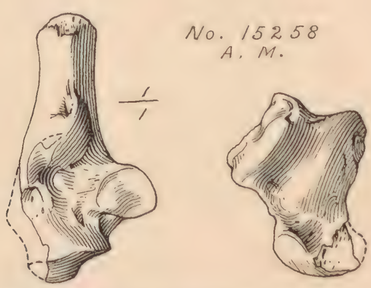

Fig. 40. *Vassacyon*, calcaneum and astragalus, superior views, natural size. No. 15258, Gray Bull beds, Big Horn Basin.

thew, 1909) is confirmed by a more careful study of their characters, with the additional material now at hand. Although the second lower molar is smaller than the first, it is the tooth which in conjunction with the first upper molar is progressively specialized as a shearing tooth. The fourth upper premolar and first lower molar, although large teeth, have very little shearing action, as is clearly shown by the wear of these teeth, and the successive species show a decided tendency to reduce these teeth wholly to the crushing (or bone-breaking?) function of the premolars. The same is true of *Patriofelis* and to a less marked extent of *Oxyæna* and the *Limnocyon* group.

In all the Oxyænidæ the carnassial angle is behind m^1; that is to say, the outer line of the dentition is angulate at that point, the teeth in advance of it being extended posteroexternally, those behind it anteroexternally, a more or less pronounced pit (*Entodiastema* of von Ihering) for the reception of the lower carnassial being developed in the palate. In the Miacidæ the carnassial angle is behind p^4, in the Hyænodonts behind m^2. This is a much more reliable guide to the affinities of the genera than is the relative size of the teeth, and conforms to a variety of differential family characters of skull and skeleton.

The Oxyænid genera do not stand in any exact successional relationship. *Patriofelis* cannot be derived from *Oxyæna,* nor from *Palæonictis* or *Ambloctonus* but from some intermediate type agreeing with the last named genus in the premolars and zygomatic arches and with the first named in the molar teeth. *Palæonictis* and *Ambloctonus* are very closely allied but appear to be divergent or at all events distinct lines of specialization. *Oxyæna* is represented by a series of species in which the shear is progressively perfected and concentrated on $m\frac{1}{2}$, premolars and molars showing a marked analogy to those of the Felidæ. The short head, deep arches, very short deep jaw, massive premolars, robust and much worn shearing teeth of *Patriofelis* and *Palæonictis* and *Ambloctonus* are analogous to the Hyænidæ, but not so closely. The smaller Oxyænids, *Limnocyon* and its allies, offer a broad analogy to the Viverridæ; and just as the Felidæ and Hyænidæ are structurally derivable from the Viverridæ, so are the larger and more specialized Oxyænidæ structural derivatives of the *Limnocyon* group. Of the two genera which represent this last group in the Lower Eocene, one, *Prolimnocyon,* has the most primitive dentition of any Oxyænid; the other *Dipsalidictis,* with the dentition of *Limnocyon,* has the primitive foot-structure of *Oxyæna.* But *Oxyæna* itself occurs in the Clark Fork horizon along with *Dipsalidictis,* so that the common ancestry of the genera was well down in the Paleocene.[1] Each genus includes one or more phyla of true genetic descent, so far as one may judge from the evidence.

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[1] But the ancestral types have not been found, or at all events have not been recognized in the Puerco and Torrejon faunæ, and hence the family Oxyænidæ must be regarded as an immigrant group appearing in North America at the close of the Paleocene.

Key to Genera of Oxyænidæ.

A. Two subequal shearing molars, m_1 and m_2; $p^{\underline{3}}$ without internal cusp or root; m^2 transverse, unreduced.
   1. $M\frac{3}{3}$ present, small or vestigial.......................... *Prolimnocyon.*
   2. $M\frac{3}{3}$ absent, astragalar trochlea flat...................... *Dipsalidictis.*
   3. $M\frac{3}{3}$ absent, astragalar trochlea grooved.......... *Thinocyon, Limnocyon.*

B. M_2 as large or larger than m_1; p^3 with internal root and usually cusp.
   4. $M^{\underline{2}}$ transverse; m_2 with distinct metaconid and heel.......... *Oxyæna.*
   5. $M^{\underline{2}}$ absent; m_2 with vestigial metaconid and heel............ *Patriofelis.*

C. $M_{\overline{2}}$ smaller than m_1; $p^{\underline{3}}$ with internal cusp.
   6. $M^{\underline{2}}$ small, not transverse; metaconid on m_2.............. *Palæonictis.*
   7. $M^{\underline{2}}$ small, transverse; no metaconid on m_2............ *Ambloctonus.*

Oxyæna *Cope* 1874.[1]

Type, O. lupina from Wasatch of New Mexico.

The types of the three species described by Cope are from New Mexico, where the genus is fairly common. A number of topotypes obtained by Mr. Granger in 1912–13 serve to check the validity of these species and to compare them with the more numerous and better preserved specimens secured in the Big Horn Valley. The genus occurs also in the Lost Cabin stage represented by more progressive and larger species, and in the Clark Fork and Sand Coulée horizons is represented by more primitive species.

The progressive characters of *Oxyæna* are toward a higher predaceous specialization. The carnassial teeth $m\frac{1}{2}$ develop a more perfect shear on the trigon and the metaconid and heel of m_2 tend to disappearance. The earlier species are more like *Limnocyon* and *Palæonictis* in various respects, and the divergence between the three phyla becomes emphasized later on. The geological horizon of the species of *Oxyæna* from first to last is in exact accord with their progressiveness.

Key to Species of Oxyæna.

I. $M_1 = m_2$
   A. Trigonid of m_2 broader than long, heel large.
      1. Size small.. *O. æquidens.*

II. M_1 smaller than m_2
   B. Trigonid of m_2 slightly broader than long, heel large.
      2. Size small, p_1–m_2 = 59 mm......................... *O. transiens.*
   C. Trigonid of m_2 somewhat longer than broad, heel moderate.
      3. Size small medium, p_1–m_2 = 65–70........................ *O. gulo.*
      4. Size large, p_1–m_2 = 80–85 mm......................... *O. forcipata.*
   D. Trigonid of m_2 considerably longer than broad, heel small.
      5. Size medium.. *O. lupina.*
      6. Size largest. Molar teeth insufficiently known........... *O. pardalis.*

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[1] Cope, 1874, Rep. Vert. Fors. New Mex., p. —

The geologic level of these species is as follows:

	Wyoming	New Mexico	
Lost Cabin	O. pardalis	O. lupina	Largo
Lysite	O. forcipata?		
Gray Bull	O. forcipata, O. gulo.	O. forcipata, ? gulo	Almagre
Sand Coulée	O. transiens		
Clark Fork	O. æquidens, O. sp. innom.		

?**Oxyæna** sp. innom.

To this genus should perhaps be referred No. 16068, fragmentary upper jaws, etc., from the Clark Fork horizon. The teeth differ from those of *O. forcipata* in greater transverse extension of p^4 and approach *Palæonictis* in cusp construction. The specimen is too fragmentary for positive reference, but is evidently a larger animal than either *O. forcipata* or *P. occidentalis*. The canines are extremely robust, and much larger than in *Oxyæna* and the reference to this genus is very questionable.

Oxyæna æquidens sp. nov.

Type, No. 16070, lower teeth of one individual from Clark Fork beds of Clark Fork Basin, Wyoming.

Distinctive characters: Trigonids of lower molars wider than long; m_{1-2} subequal in size; heels relatively large; p_4 very robust with minute anterior basal cusp; canine robust with massive root. Size about that of *O. gulo*.

Oxyæna transiens sp. nov.

Type, No. 16118, upper and lower jaws from the Sand Coulée horizon, Clark Fork Basin, Wyoming.

Distinctive characters: (1) trigonids of lower molars wider than long; (2) m_1 smaller than m_2; (3) premolars less robust than in *æquidens*, canine less massive; (4) metastyle of upper carnassial less extended than in any of the later species; (5) deuterocone of p^4 without posterior flange; (6) p^3 with internal root but no distinct internal cusp (deuterocone).

Characters 1, 4, 5, and 6 are distinctive from all the later species and in agreement with observed or inferential characters of *O. æquidens;* nos. 2 and 3 distinguish it from that species and are in accord with the later species.

Size smaller than *O. gulo*.

No. 16179 from a somewhat higher level in the Gray Bull beds of Clark Fork Basin agrees fairly well with the type but the size is somewhat larger, the lower molars more nearly equal, and p^4 has the posterior flange of the deuterocone more developed. It appears to be transitional to *O. gulo*.

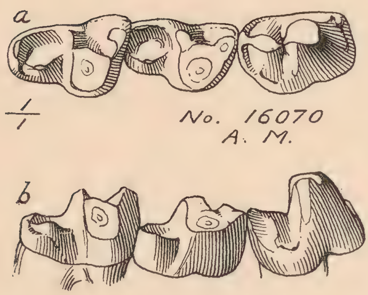

Fig. 41.

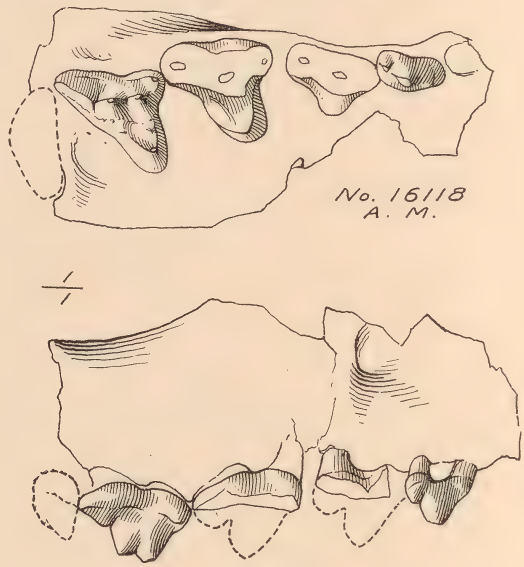

Fig. 42.

Fig. 41. *Oxyæna æquidens*, lower teeth, p_4–m_2, crown and outer views, natural size. Type specimen, Clark Fork beds, Clark Fork Basin.

Fig. 42. *Oxyæna transiens*, upper jaw of type specimen, natural size, occlusal and outer views. Sand Coulée beds, Clark Fork Basin.

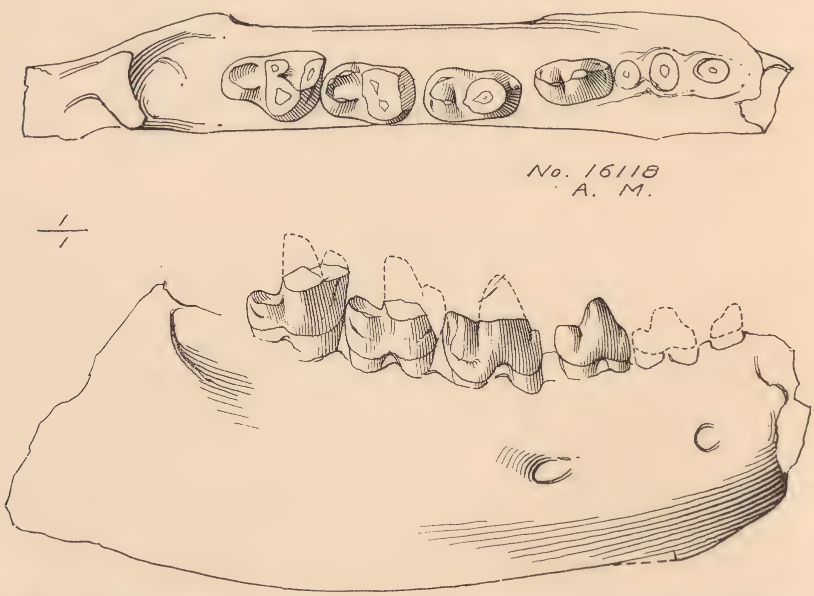

Fig. 43. *Oxyæna transiens*, lower jaw, outer and occlusal views, natural size. Type specimen, Sand Coulée beds, Clark Fork Basin.

Oxyæna lupina *Cope* 1874.

Oxyæna lupina COPE 1874, Rep. Vert. Foss. New Mex., p. 11; 1875, Syst. Cat. Eoc. Vert. New Mex., p. 123; 1877, Ext. Vert. New Mex., p. 101, pl. xxxiv, figs. 14–37, pl. xxxv, figs. 1–4.

Syn., Oxyæna huerfanensis OSBORN 1897, Bull. A. M. N. H., Vol. IX, p. 255.

Oxyæna morsitans COPE 1874, *l. c.*

Type, U. S. Nat. Mus. No. 1049, upper and lower teeth and a few skeleton fragments, from Wasatch of New Mexico. Figured in 1877, l. c., pl. xxxiv, figs. 14–30.

Distinctive characters: (1) trigonids of lower molars longer than wide, metaconid and heel of m_2 much reduced; (2) m_1 smaller than m_2 (in all specimens with the doubtful exception of the type); (3) premolars moderately compressed, anterior basal cusp of p_4 well developed; canines moderately long; (4) metastyle of upper carnassial much elongate and m^2 reduced in size; (5) deuterocone of p^4 with posterior flange; (6) p^3 with distinct internal root.

The large amount of additional material for comparison, including topotypes from the New Mexican Wasatch shows that this species is distinct and decidedly more progressive than the Big Horn specimens which have been referred to it by Osborn and Wortman. The metaconid and heel of m_2 are much smaller, the shear more anteroposterior, the metastyle of m^1 more extended, and m^2 evidently more reduced. *O. huerfanensis* agrees with the type of *O. lupina,* although not with the incorrectly referred Big Horn specimens with which Osborn's comparisons were made.

Nos. 16219, 16755 and 16216, lower jaws from the New Mexican Wasatch, agree with *O. lupina,* except for slightly smaller size. The two former are from the upper faunal zone, the third from the top of the lower zone. A fourth specimen, No. 16218, consisting of milk and unworn permanent teeth and other fragments is more doubtfully referable; it is from the lower beds.

Oxyæna forcipata *Cope* 1874.

Oxyæna forcipata COPE, 1874, Rep. Vert. Foss. New Mex., p. 12; 1875, Syst. Cat. Vert. Soc. New Mex., p. 105, pl. xxxvi, xxxv, figs. 7–12, xxxvii, figs. 1–5; 1885, Tert. Vert., p. 318, pl. xxxivb, xxivc. OSBORN, 1892, Bull. A. M. N. H., Vol. IV, p. 109.

Oxyæna lupina OSBORN, 1892, Bull. A. M. N. H., Vol. IV, p. 108, fig. 9; WORTMAN; 1899, *ibid.*, Vol. XII, p. 140, pl. vii and text figs. 1 and 2; OSBORN, 1900, *ibid.*, Vol. XIII, p. 276, pl. xviii.

Not *O. lupina* of Cope.

Type, U. S. Nat. Mus. No. 1029, lower jaws from the Wasatch of New Mexico.

Distinctive characters: (1) trigonids of lower molars about as long as wide, metaconid and heel of m_2 moderately large; (2) m_1 smaller than m_2; (3) premolars more robust than in *lupina*, less than in *æquidens*, p_4 with distinct anterior basal cusp; (4) upper molars relatively larger than in *lupina*, carnassial metastyle less elongate;

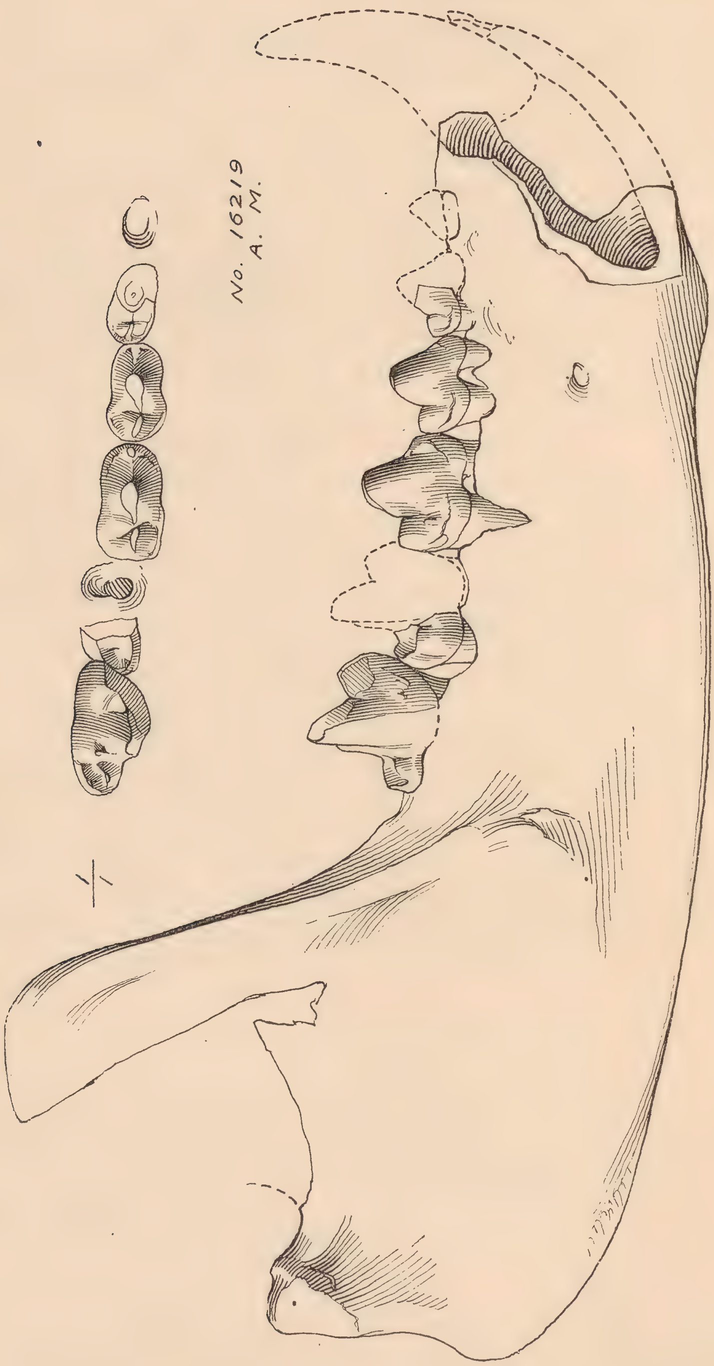

Fig. 44. *Oxyæna lupina*, lower jaw, outer view and crown view of teeth, natural size. Topotype, No. 16219, Largo beds, Wasatch formation, San Juan Basin, New Mexico.

(5) deuterocone of p^4 with heavy posterior flange; (6) inner cusp of p^3 more prominent than in *lupina;* (7) size larger than lupina, teeth more robust throughout, jaw deeper and more massive.

To this species are referred the larger specimens from the Gray Bull horizon in the Big Horn Basin, including the mounted skeleton described by

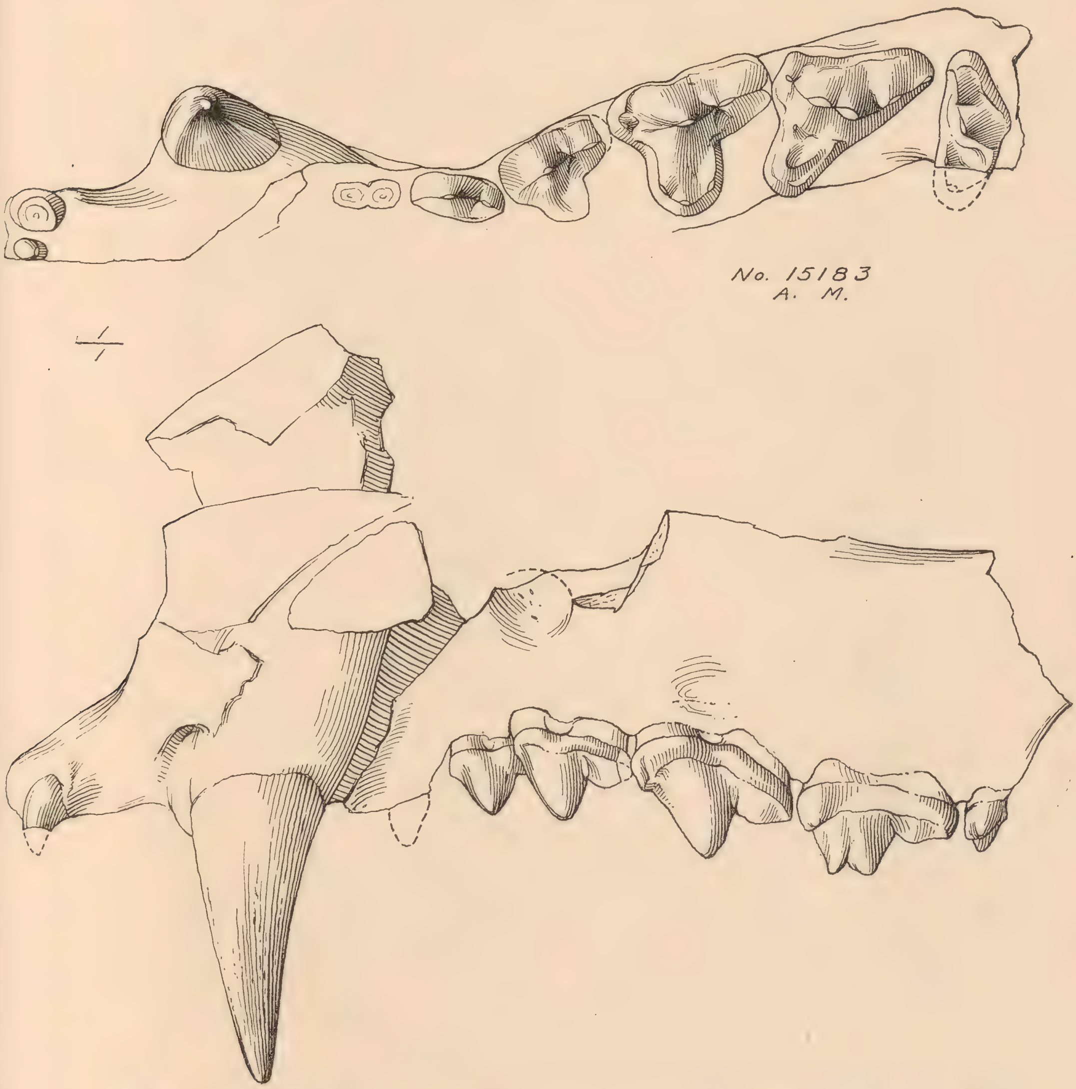

Fig. 45. *Oxyæna forcipata,* upper jaw, outer and occlusal view, natural size. From No. 15183, Gray Bull beds, Big Horn Basin.

Wortman as *O. lupina.* Cope referred to *O. forcipata,* all the Big Horn Basin specimens in his collection, including parts of this same skeleton; our additional material confirms the reference. In addition to the skeleton

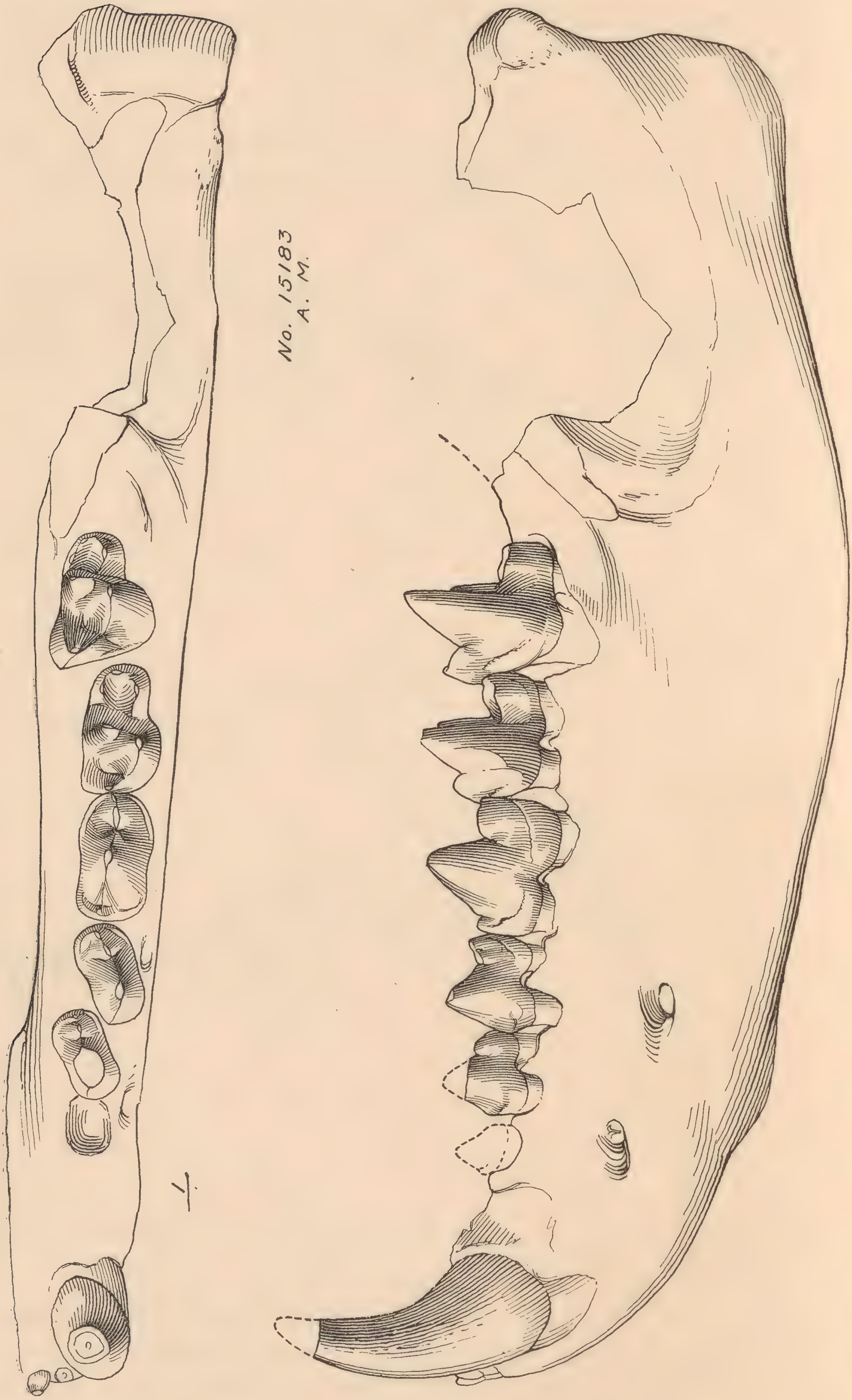

Fig. 46. *Oxyæna forcipata*, lower jaw, external and superior views, natural size. No. 15183, Lower Gray Bull beds, Big Horn Basin.

A. M. No. 107, there is a considerable series of well preserved lower jaws, some of them associated with upper jaws, and a few with parts of the skeleton; and a larger number of fragmentary specimens. These vary considerably in size, in robustness of teeth and depth of jaw and various other characters.

Oxyæna gulo sp. nov.

Type, No. 15199, upper and lower jaws; paratypes, Nos. 15725, upper and lower jaws, 15193, 15722, lower jaws. All from the Gray Bull horizon of the Big Horn Wasatch.

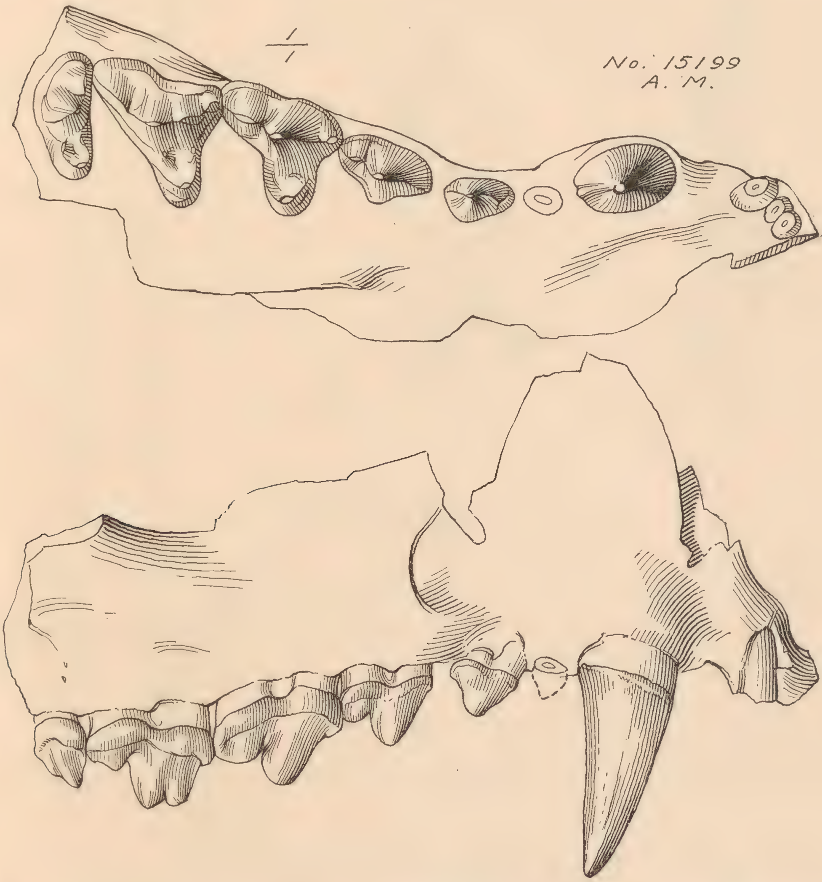

Fig. 47. *Oxyæna gulo*, upper jaw of type specimen, crown and outer views, natural size. Lower Gray Bull beds, Big Horn Basin.

Distinctive characters: (1) trigonids of lower molars about as long as wide, metaconids and heel of m_2 moderately large; (2) m_1 smaller than m_2 (3) premolars moderately robust sometimes crowded and set transversely, p_4 with high protoconid and no anterior basal cusp; (4) m^1 wide transversely, metastyle little extended, m^2 trans-

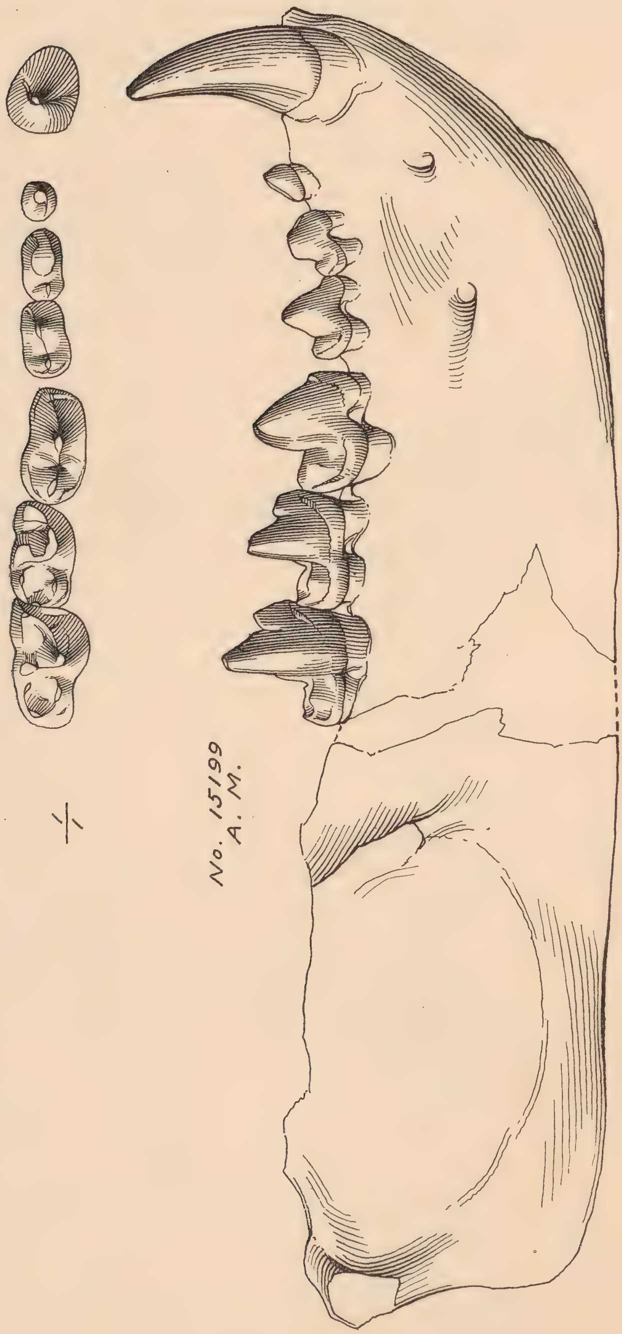

Fig. 48. *Oxyæna gulo*, lower jaw, outer view, and crown view of teeth, natural size. From the type specimen, molar eeth partly restored from No. 15193. Gray Bull beds, Big Horn Basin.

versely wide; (5) slight internal flange on deuterocone of p^4; (6) p^3 with no internal cusp; (7) size smaller than *O. forcipata*, averaging less than *lupina*, considerably larger than *transiens.*

This species is about as common as *O. forcipata* in the Big Horn Wasatch, and is readily distinguished from it in the characters, 3 to 7, cited above. It is larger and somewhat more progressive than *O. transiens* which appears to be ancestral. One or more of the specimens from New Mexico referred by Cope to *O. morsitans* may belong to this species but the type of Cope's species is clearly distinguished by the smaller metaconid and heel on the molars.

Measurements.

			15199	*15725*	*15193*
Upper teeth,		i^1–m^2	87.5		
"	"	c^1–m^2	72.	81	
"	premolars	p^1–p^4	41.5	42	
"	molars	m^{1-2}	20.5	23	
Diameters of p^4		a–pxtr	14.5 × 13.5	15 × 14	
"	" m^1	"	14 × 14	16.5 × 16.5	
"	" m^2	"			
Lower teeth,		c_1–m_2	80	88	
"	premolars	p_1–p_4	37.5	40.5	
"	molars	m_{1-2}		28.5	25.5
M_2 anteroposterior				17	15.5
" transverse				11	9
" length of heel				5.5	5

Oxyæna pardalis sp. nov.

Type, A. M. No. 15607, anterior portion of lower jaws with a large part of the skeleton, from the Lost Cabin Horizon, Big Horn Basin, Wyoming. Paratype, No. 15608, lower teeth from Lysite beds of Big Horn Basin, Wyo.

Distinctive characters: (1) trigonids of lower molars longer than wide, metaconid of m_2 vestigial and heel much reduced; (2) m_2 smaller than m_1; (3) premolars moderately robust, p_4 with distinct anterior basal cusp and exceptionally broad heel, canines more massive than *O. forcipata;* (7) size larger than *O. forcipata*, much larger than *O. lupina.*

The skeleton parts of the type of *O. pardalis* are in close agreement with *Oxyæna forcipata.* The limb bones, feet and many of the vertebræ are very well preserved, much more perfect and complete than in the skeleton of *O. forcipata* from the Gray Bull horizon of the Big Horn Basin described by Cope,[1] Osborn,[2] and Wortman.[3]

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[1] Tertiary Vertebrata, p. 318, pl. xxivb, xxivc.
[2] Bull. A. M. N. H., Vol. IV, p. 108, fig. 9; *ibid.*, Vol. XIII, p. 276, pl. xviii.
[3] *ibid.*, Vol. XII, p. 140, pl. vii.

The specimen consists of complete pelvis, hind limbs and feet, lumbar and caudal vertebræ, fragments of the fore limbs and parts of fore feet, anterior part of lower jaws, fragments of upper teeth and lower molars. With this individual were associated parts of hind limbs of two other individuals of the same species, a jaw and a few fragments of skeleton of *Sinopa*.

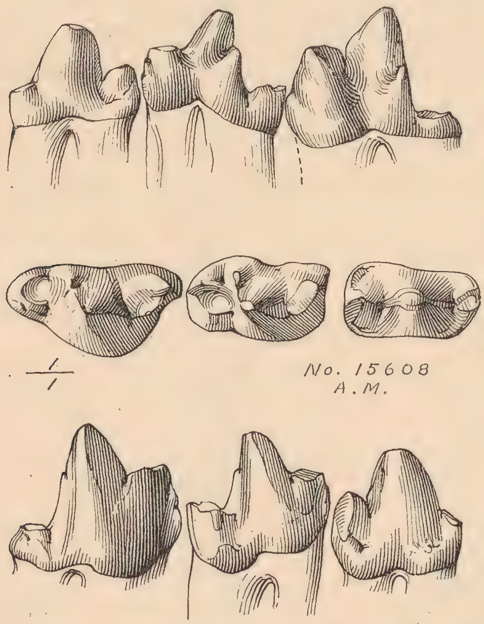

Fig. 49. *Oxyæna pardalis*, **lower teeth,** p_4–m_2 **inner, crown and outer views, natural size. No. 15608, Lysite beds, Big Horn Basin.**

The scaphoid, centrale, magnum, unciform, trapezoid, trapezium cuneiform and pisiform are preserved in the carpus. The centrale lies beneath the scaphoid, completely separating the trapezoid from it; dorsally the centrale projects beneath the lunar as well. The articulation between centrale and scaphoid is rugose, foreshadowing the union of these two bones; the lunar-scaphoid facet is also but less clearly of the same character. The unciform is about the same in height as in breadth, and has a broad lunar articulation, not distinct from that for the cuneiform except dorsally. The magnum is small, with narrow proximal keel, small dorsal surface. The trapezium is large, with a proximal internal peg extending beneath the trapezoid; its facet for mc.I is large, but nearly flat.

The femur has a third trochanter, rather obscure; the shaft is bowed outwardly, considerably flattened and ridged on the external border both above and below the trochanter. The tibia is one-fifth shorter than the femur, the cnemial crest is very slight, the internal malleolus thick and massive, the trochlea nearly flat and very oblique.

The astragalus has a broad, nearly flat trochlea, the inner crest obscure, the outer crest a sharp ridge with a solid angle of 90° separating the trochlea from the fibular facet. The fore and aft motion of the tibia on the astragalus is quite narrowly limited by the astragalar foramen behind, and the neck of the astragalus in front. At the front of the trochlea the facet is sharply curved upwards to receive the front of the tibia in flexion, and on the inner slope of the neck is a well defined facet for the internal malleolus n flexion. The neck is very oblique, the head broad and flat. The navicu ar is wide, and of little height. The mesocuneiform is somewhat oblique but lacks the extreme obliquity of *Vulpavus;* the entocuneiform is deep, high and not wide, the first digit has a slightly saddle-shaped facet, but does not seem to have been at all opposable.

The symmetry of the digits is not fully mesaxonic; mt.V is intermediate in length between mt. IV and I. The metapodials are rather short and spreading; the proximal and median phalanges are much broader than in Miacidæ, somewhat asymmetric but not excavated. The ungual phalanges are strongly curved, uncompressed, and rather deeply fissured at the tips.

The lumbar, posterior dorsal and anterior caudal vertebræ have deeply concave zygapophyses. The pelvis is moderately expanded above the iliac bar; the ischium is long and broad with the spine expanded into a considerable plate. The sacrum appears to consist of but two coössified vertebræ, the third in this young individual being still separate, although of sacral type.

Palæonictis.

A number of upper and lower jaws of this genus were obtained in the Big Horn Wasatch, and a few skeletal fragments, but nothing to supply much information as to the skeleton, and nothing as good as the fine specimen of *P. occidentalis* obtained by Wortman in 1891 and described in the Museum Bulletin in 1892. As shown clearly in the 1891 specimen the second lower molar of *Palæonictis* is a reduced copy of the first, with tricusped trigonid, and fairly large basin heel. The second upper molar is a small rounded one-rooted tooth, not transverse.

The species of *Palæonictis* and *Ambloctonus* are readily distinguished from those of *Oxyæna* by the more massive premolars, transverse width of upper p^4, m^1 with higher and more pointed cusps but less perfect shear, the smaller trigonid and larger heel of m_1 and reduction of $m\frac{2}{2}$. M^1 is developed as a carnassial as in *Oxyæna,* but to a less extent. In this feature lies an obvious reason for associating these genera with Oxyænidæ and not with the Eucreodine group. While in *Palæonictis* the second upper molar is vestigial, in *Ambloctonus* it is transverse, and in other respects this genus links the better known *Palæonictis* to *Oxyæna.*

? Palæonictis sp.

To *Palæonictis* may be referred with much hesitation a specimen from the Gray Bull beds, No. 15217, consisting of the greater part of the hind foot, three caudal vertebræ and a few other fragments. It is of larger size than would be indicated by the associated fragments with the closely related genus *Ambloctonus,* not much smaller than *Patriofelis.* Both astragali are present, and compare with the Bridger and Washakie species of *Limnocyon.* The trochlea is distinctly grooved, narrower transversely and more concave and elongate antero-posteriorly than in *Oxyæna, Patriofelis* or *Dipsalidictis;* the neck is rather short and the head wide but of considerable depth towards its external side. The calcaneum is not preserved; the navicular is broad and of little height but considerable dorso-ventral depth with a heavy inferior hook projecting beneath the cuneiforms. The mesocuneiform is small, much like that of *Oxyæna;* the entocuneiform deep dorso-ventrally, with heavy inferior hook, large navicular facet and deep facet for mt. I. Of the metatarsals mt. III–V of the right side are complete, III and IV of nearly equal length, V one-fifth shorter, and somewhat stouter in shaft. They are of moderate length, comparable to *Oxyæna* in proportions, although much larger. The phalanges are much longer than in *Oxyæna,* their combined length one fourth greater than that of the metatarsal while in *Oxyæna* the metatarsal is as long as the three phalanges, and in *Patriofelis* it is longer. The second phalanx is not flattened as in *Oxyæna;* the ungual is larger, longer, less curved, somewhat more compressed, and with a deep but narrow fissure.

Three vertebræ from the middle caudal region indicate a long, heavy tail.

This specimen belongs to the Pseudocreodi as indicated by the fissured unguals, not flattened as in Mesonychidæ. It is very clearly distinguished from *Oxyæna* and *Patriofelis,* and approximates *Limnocyon* in the proportions of the phalanges. There is no known Lower Eocene Creodont to which it could belong except *Palæonictis,* and its ascription to any known species of that genus involves wide difference from *Ambloctonus* in size of skeleton relative to skull. If not *Palæonictis* it is an otherwise unknown Oxyænid or less probably an unknown Hyænodont.

Palæonictis occidentalis *Osborn.*

Palæonictis occidentalis Osborn 1892, Bull. A. M. N. H., Vol. IV, p. 104, pl. iv.

Type, No. 110, front of skull and lower jaws from the Gray Bull beds, Big Horn Basin, Wyoming.

Distinctive characters: Premolars $\frac{4}{4}$ m^2 small, rounded; m_2 with strong metaconid, and small basin heel.

The last mentioned character distinguishes the species from *P. gigantea* of the Suessonian.

To this species I refer a number of upper and lower jaws, Nos. 15211, 15213–6, 16178, from the Systemodon zone of the Big Horn Wasatch. The genus has not been found in New Mexico nor later than this zone.

Ambloctonus *Cope* 1875.

Generic characters: Premolars and m^1 very like *Palæonictis;* m^2 small, two-rooted transverse; m_2 with no metaconid. Heel of m_1 progressively trenchant; heel of m_2 progressively reduced. Zygomata wide and deep, as in *Palæonictis* and *Patriofelis.*

Although not observed by either Cope or Wortman there is no doubt of the presence in the type of *A. sinosus* of a small transverse molar behind

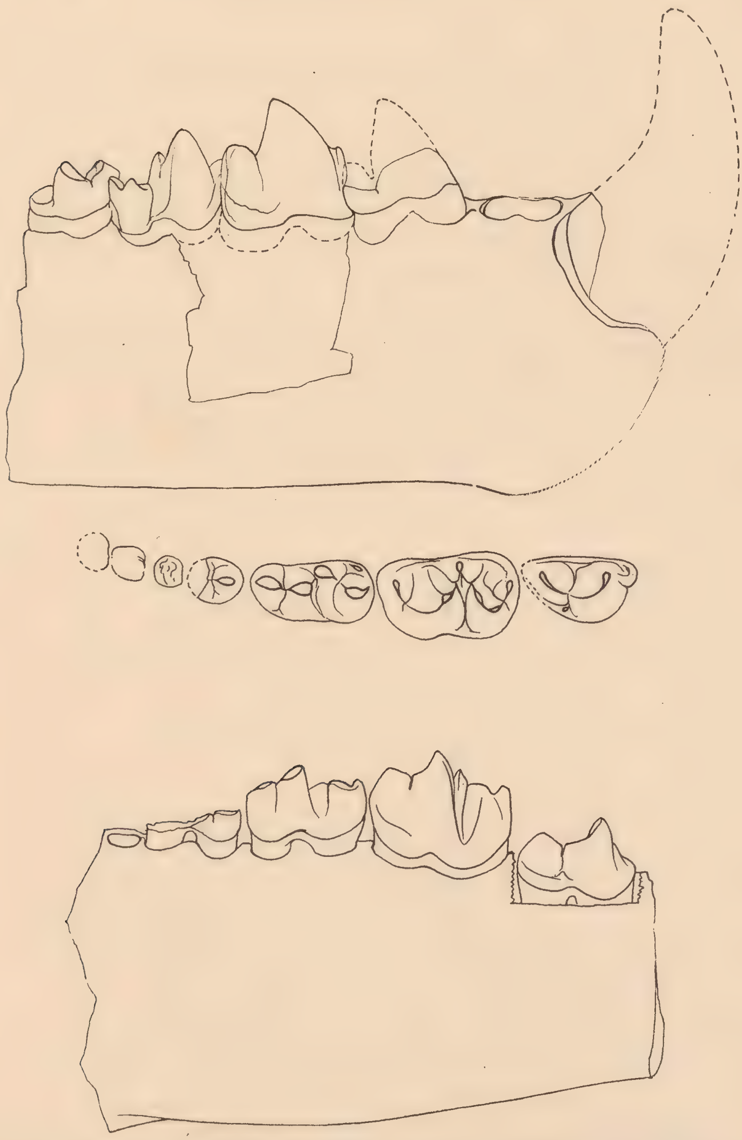

Fig. 50. *Ambloctonus*, lower jaws; above, *A. priscus*, permanent dentition, outer view, below *A. hyænoides*, milk premolars and m_{1-2}, outer view and crown view of teeth. All natural size.

m^{1}. Cope misinterpreted the upper teeth, an error corrected by Wortman in 1892. The genus is nearly allied to *Palæonictis,* distinguished by the more shearing type of the posterior teeth. Two species are represented in our collection, one from the Clark Fork and lower Gray Bull levels, decidedly more primitive, the other from the Lysite or Lost Cabin, distinctly more progressive than the type species.

The transverse m^{2} is preserved in the more primitive species. The tooth may have been absent in the more progressive *A. hyænoides.*

Ambloctonus priscus sp. nov.

Type, No. 15212, fragmentary skull and jaws, etc., from the Gray Bull horizon three miles north of Otto in the Big Horn Basin, Wyoming. Paratypes Nos. 16116, 16117, upper and lower jaws from Clark Fork horizon, Clark Fork Basin, Wyoming.

Specific characters: Smaller than *A. sinosus,* teeth less robust, heel of m_2 much less reduced, with three cusps enclosing a basin.

The type is a young individual with unworn teeth, and m^2 not yet erupted. No. 16116 supplies the characters of this tooth.

Fig. 51. *Ambloctonus priscus,* upper teeth, type specimen, natural size, external and crown views.

There are four lower premolars, much crowded, the first one-rooted, the others two-rooted; p_2 is set obliquely in the jaw. P_4 has two postero-internal cingular cusps, absent in *Palæonictis,* but is otherwise like that genus, as are the other premolars in number and form. M_1 is constructed as in *Palæonictis occidentalis,* but the heel is higher. M_2 differs in the absence of metaconid, but is quite as large as in *P. occidentalis.* The upper teeth compare closely with that species except for m^2 which in the type is buried in the jaw but in No. 16116 is a small transverse two-rooted tooth with a moderately large parastyle, little extended, a strong paracone, vestigial metacone, and compressed transversely trenchant protocone. The zygomatic arches are deep, wide and short, the sagittal crest thick and low.

Fragments of the humerus and ulna indicate a construction similar to *Oxyæna* but shorter and thicker proportions, and a relatively larger head.

Ambloctonus sinosus *Cope* 1875.

Ambloctonus sinosus Cope 1875, Syst. Cat. Vert. Eoc. New Mex., p. 7 (Apr. 17); 1877, Ext. Vert. New Mex. Rep. U. S. G. S. 100th Mer., p. 91, pl. xxxiii; Osborn & Wortman, 1892, Bull. A. M. N. H., Vol. IV, p. 106, fig. 8.

Type, U. S. Nat. Mus. No. 2329, fragmentary upper and lower jaws and a few fragments of skeleton.

A careful examination of the type specimen shows two small transversely set alveoli behind m^1, indicating a small transverse m^2. The second lower molar has no metaconid, but the heel is a distinct high-pointed cusp with a heavy cingulum internal to it.

The second specimen referred by Cope to *A. sinosus* is considerably larger than the type, and the second molar appears to have no heel. I have therefore transferred it to *A. hyænoides.*

Ambloctonus hyænoides sp. nov.

Type, No. 16215, a lower jaw with dp_{3-4} and m_{1-2} from the upper horizon of the New Mexican Wasatch. Paratype, U. S. Nat. Mus. No. 5377, lower jaw with p_4–m_2 considerably worn, from the Wasatch of New Mexico. No. 16853, jaw fragment with dp_4–m_1 from Lost Cabin horizon at head of Whistle Creek, Big Horn Basin, is also referred here.

Specific characters: About one seventh larger than *A. sinosus;* m_2 without heel.

The molar teeth in the type are unworn, and show the peculiar construction very well. The three cusps of the trigonid on m_1 are united by a sharp curving crest, the high hypoconid is also developed as a curved crest, a small crest projecting towards it from the metaconid separated by a narrow cleft and the inner heel cusp has disappeared. The tooth is essentially composed of two crescents concave inwardly. The second molar is composed of but two cusps, pa^d and pr^d, which form a high crescent like that of the trigonid of m_1, differing in the absence of metaconid and heel. A strong internal and posterointernal cingulum is the only trace left of the heel.

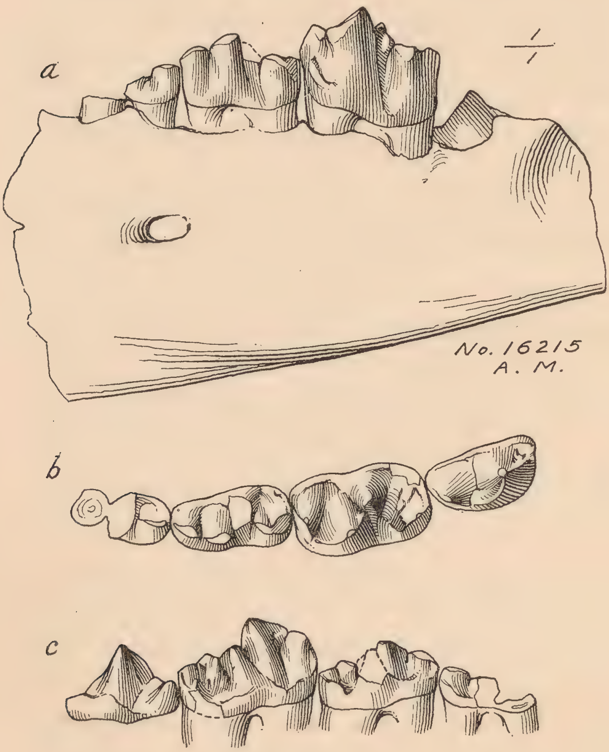

Fig. 52.

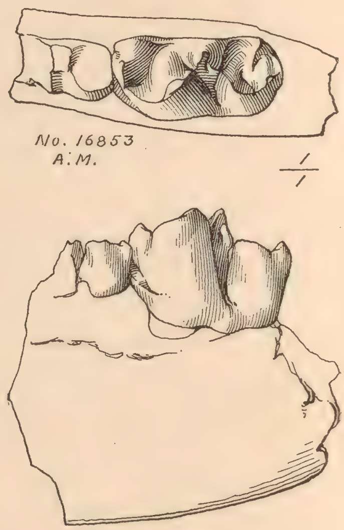

Fig. 53.

Fig. 52. *Ambloctonus hyœnoides*, lower jaw, outer view, and crown and inner views of teeth, dp_{3-4}, m_{1-2}, natural size. Type specimen, upper (Largo) horizon, Wasatch formation, San Juan Basin.

Fig. 53. *Ambloctonus hyœnoides*, jaw fragment from the Big Horn Basin, Wyoming, Lost Cabin beds. Natural size, external view and crown view of last milk molar and first true molar.

The paratype shows that the shearing action on m_1 was imperfect; m_2 in spite of its smaller size, appears to be the real carnassial or principal shearing tooth, as m^1 certainly is in the upper jaw. The cusp-construction of $m\frac{1}{2}$, similar in many respects to that of $\frac{p^4}{m_1}$ of the hyæna, together with the large robust crowded premolars, suggest the specific name.

Ambloctonus coloradensis (*Matthew* 1909).

Patriofelis ulta Osborn 1897, Bull. A. M. N. H., Vol. IX, p. 256; 1900, *ibid.*, Vol. XIII, p. 278, fig. 8.

Patriofelis coloradensis Matthew 1909, Bull. U. S. G. S., 361, p. 96; Mem. A. M. N. H., Vol. VI, p. 432.

Type, A. M. No. 2691, lower jaws, from the upper beds, "Bridger" of the Huerfano Basin.

A reëxamination of this specimen suggests that its affinities are close with *A. sinosus*. It is somewhat smaller and less robust, and is recorded as from a later level, associated with *Tillotherium*. For these reasons it is better retained for the present as a distinct species.

Patriofelis (*Protopsalis*).

Protopsalis is transitional from *Oxyæna* to *Patriofelis* proper, but is in all respects more like the Bridger genus, despite its retention of a small heel on m_2. It has not usually been considered as deserving of generic separation.

Patriofelis tigrinus (*Cope* 1880).

Protopsalis tigrinus Cope 1880, Amer. Nat., Vol. XIV, p. 745; 1885, Tertiary Vertebrata, p. 322, pl. xxvb, figs. 1–7; (*Patriofelis*) Wortman 1894, Bull. A. M. N. H., Vol. VI, p. 130; Osborn, 1900, *ibid.*, Vol. XIII, p. 278, fig. 7.

Type, A. M. No. 4805, part of lower jaw and a few fragments of skeleton, from the Lost Cabin horizon in the Wind River Basin, Wyoming.

Two fragmentary specimens from the same horizon as the type, Nos. 14778–9, were secured by the Expedition of 1909 in the Wind River basin. As in the type, the second lower molar has a vestigial metaconid, and small but distinct heel. P_4 is massive, with strong anterior cusp and broad heel cusp. P^4 has a strong anteroexternal cusp and the deuterocone is less extended inwardly than in *Oxyæna*. In all these features the teeth agree with *Patriofelis*.

Dipsalidictis gen. nov.

Type, *D. platypus*, infra.

Generic Distinctions: deuterocone on p^4 only; m^2 transverse, unreduced, m^3 absent; m_1 and m_2 subequal, tuberculosectorial with large basin heels, m_3 absent; P_1 one-rooted; antero-external cusp of p^4 prominent; no fibulo-calcanear facet; astragalus with flat wide trochlea, limited anteroposteriorly, inner crest not defined, neck short, head wide and flat, not deep.

This genus has the dentition much as in *Limnocyon;* but the tarsus is more platyarthran than in *Oxyæna* or *Patriofelis*, much more than in *Limnocyon*. The dentition differs from that of *Limnocyon* only in the one-rooted first premolar and distinct protostyle, and except for the very marked difference in the tarsus, I should not be disposed to separate it from that genus. It may prove to be an ancestral stage of *Limnocyon* but as the evidence stands at present this is doubtful. The single species is known only from the Clark Fork beds; in the later horizons of the Lower Eocene no

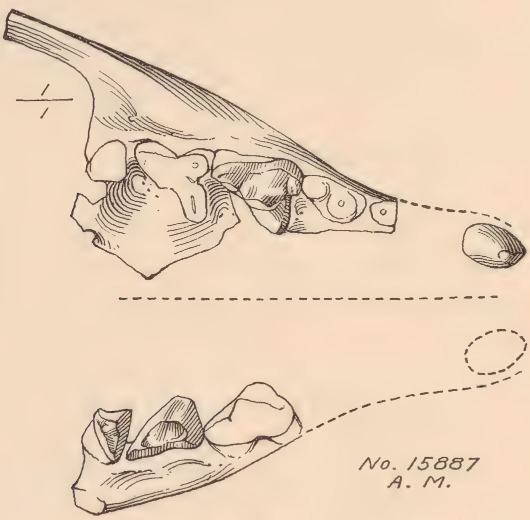

Fig. 54.

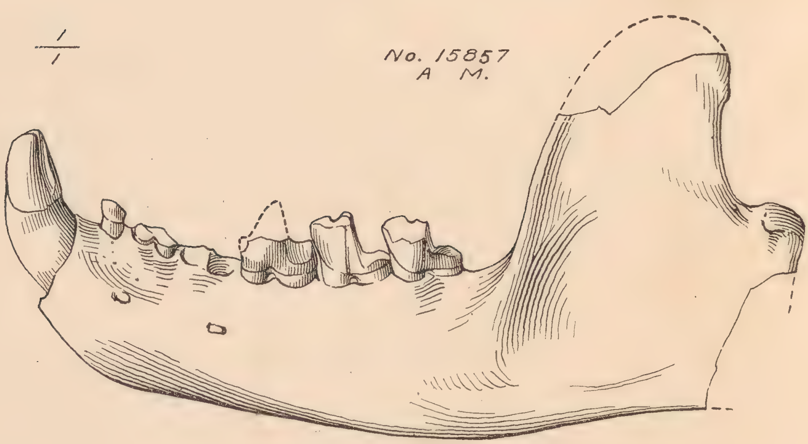

Fig. 55.

Fig. 54. *Dipsalidictis platypus*, upper jaws of type, palatal view, natural size. Clark Fork beds.

Fig. 55. *Dipsalidictis platypus*, lower jaw of type, natural size, external view. Clark Fork beds, Clark Fork Basin, Wyoming.

intermediate forms are known to occur while *Prolimnocyon* is fairly common. Which if either of these genera should be regarded as more directly ancestral to *Limnocyon* and *Thinocyon*, is not clear.

Dipsalidictis platypus sp. nov.

Type, No. 15857, upper and lower jaws and considerable part of skeleton from Clark Fork beds, 3 miles north of Ralston, Big Horn Basin, Wyoming.

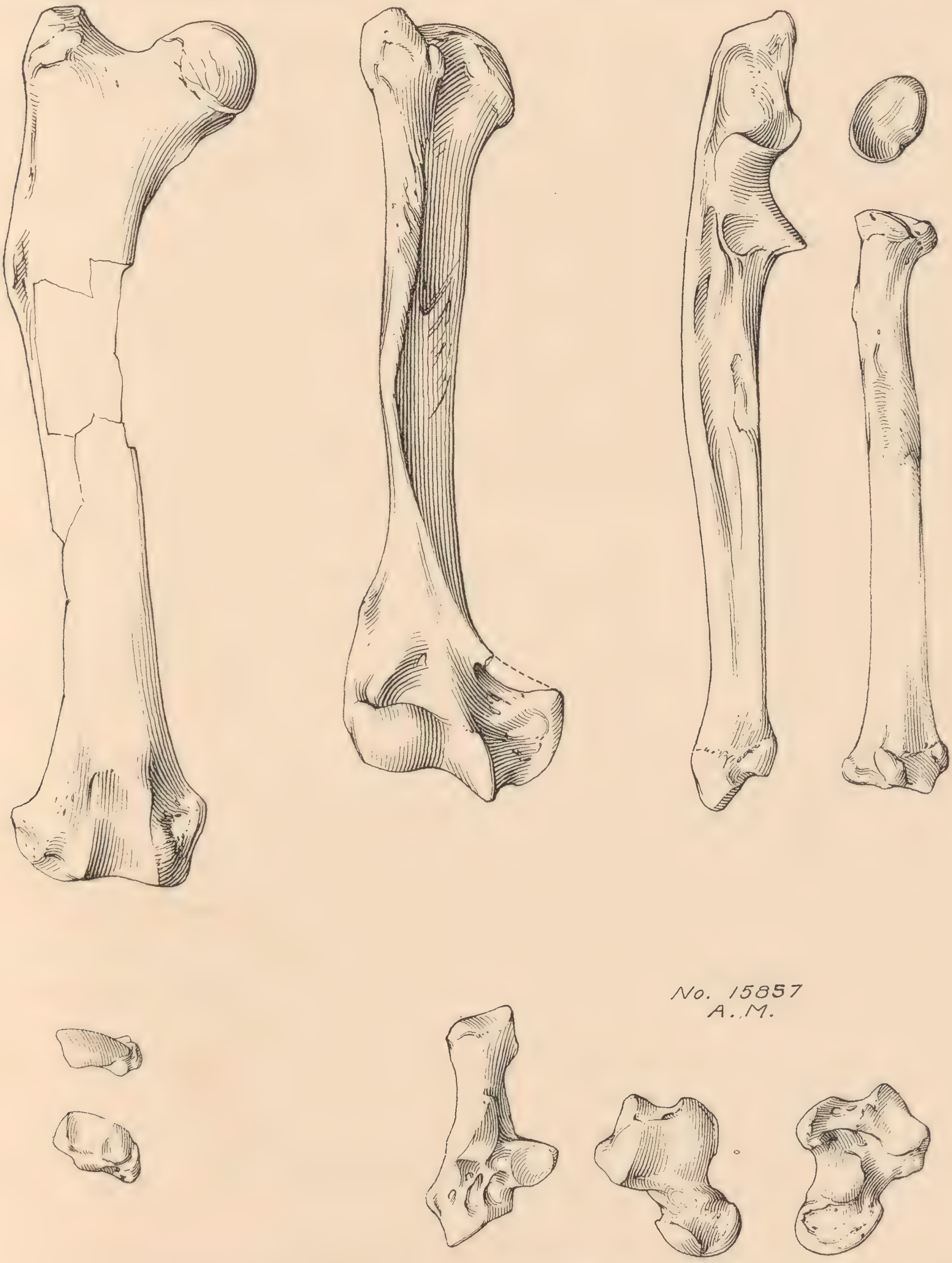

Fig. 56. *Dipsalidictis platypus*, limb and footbones of type skeleton, natural size; anterior views of femur, humerus, ulna, radius; head of radius; dorsal and distal views of scaphoid; dorsal view of calcaneum; superior and inferior views of astragalus. Clark Fork beds, Clark Fork Basin, Wyoming.

The jaws are somewhat fragmentary, the teeth considerably worn and many of them missing or broken; a few fragments of the cranium, a number of broken vertebræ, most of the limb-bones, both scaphoids and cuneiforms, the astragalus and calcaneum, and various fragments of other parts are preserved.

The skull fragments show a prominent preglenoid crest (absent in *Limnocyon,* present in *Oxyæna*), postglenoid foramen as usual in Creodonts, rather high sagittal crest, as in *Limnocyon.*

The limb bones are nearly equal in length to those of *L. verus* but much slenderer. The distal roll of the humerus is more obliquely set, the shaft is more slender, the deltoid crest less heavy and ends somewhat more abruptly. The head of the radius is round-oval instead of flattened oval as in *L. verus.* The distal end of the radius is wider, not so deep (dorsoventrally) and the shaft less curved and much more slender. The distal end of the ulna is more expanded, the shaft thinner, the olecranon shorter. The femur is much lighter in the shaft, patellar trochlea somewhat shorter, condyles not so deep or heavy. Tibia and fibula have more slender shafts, distal end of fibula less massive, and lacking calcanear facet; distal trochlea of tibia much more oblique.

The astragalus has a singularly primitive aspect, with shallow body, flattened trochlea short and wide and with no internal crest, and the very obliquely set wide flat head. The calcaneum is much straighter than in *Limnocyon,* the peroneal tubercle less prominent, fibular facet wholly absent, cuboid facet less oblique.

The scaphoid has the proximal facet extended over the entire superior surface making a sharp crest with the centrale and trapezium facets (the trapezoid probably barely touches the scaphoid). The hook of the scaphoid is not at all prominent. The cuneiform is of comparatively small height, the hook small. The pisiform has a long neck, head little expanded.

The data indicate a wide, low carpus and tarsus, primitive plantigrade feet, with limited motion in the proximal joint (tarso-crural, carpo-antebrachial).

Measurements of Type.

Lower teeth, c–m_2	54.2
" " m_{1-2}	18.2
" " p_4 length	9.1
" " m_1 "	8.1
" " m_2 "	8.7
P^3 to m^2 length	31.4
M^{1-2} length	12.7
P^3 diameters (a_1–p x tr.)	8.7 × 4.2

P^4 diameters (a_1–p x tr.)	10.4 × 8.9
M^1 " "	9.0 × 9.8
M^2 " "	4.6 × 9.9
C^1 " "	6.6 × 5.5
Jaw, length, canine to condyle	91.5
" depth beneath p_2	17.7
" " behind m_2	19.7
Humerus, length	92.5
" diameter of proximal end	21.0
" diameters of middle of shaft	14.1 × 7.3
" width of distal end	25.2
Ulna, length	92.9
" diameters of mid shaft	8.5 × 4.7
" width of distal end	10.7
" length of olecranon from upper border of radial facet	24.2
Radius, length	68.0
" diameters of prox. end	11.0 × 7.8
" " " mid. shaft	6.0 × 5.1
" " " dist. end	13.0 × 8.6
Femur, length	100.9
" diameter of head	11.8
" width of proximal end	26.0
Astragalus, diameters of body	14.3 × 10.8
" width of neck	8.3
" diameters of head	10.4 × 4.5
" diameters of tibial facet	10.3 × 10.4
Calcaneum, length	27.5

Prolimnocyon gen. nov.

Generic characters: This genus differs from all previously known Oxyænidæ in retaining a small or vestigial $m_{\overline{3}}$. Unlike the Hyænodonts the second upper molar is transverse, the carnassials being $m\frac{1}{2}$; $m\frac{3}{3}$ are quite small. The Oxyænid characters are also shown in the thick, heavy jaw with solid symphysis, and in the broad, low occiput with wide and rather short basicranial region.

The genus is represented by at least two species in the Gray Bull horizon of the Wasatch, of small size, comparing with *Thinocyon* of the Bridger. The small last molar varies in proportionate size, but in all of them it is much smaller than m_2, two-rooted, with high protoconid, small paraconid, small or no metaconid, and rather long compressed basin heel. A more progressive species is found in the Lost Cabin beds.

Key to Species of Prolimnocyon.

M_{1-3} = 14–16. M_3 small, two-rooted, metaconid usually distinct......*P. atavus.*
M_{1-3} = 21. M_3 larger, two-rooted, no metaconid, jaw deep..........*P. robustus.*
M_{1-3} = 15. M_3 one-rooted..........*P. antiquus.*

Prolimnocyon atavus sp. nov.

Type, No. 16816, part of lower jaw and fragments of skeleton from the Gray Bull horizon of the Big Horn Wasatch. Nos. 16815–8, 15165–15172, 15720 and a number of other specimens from the same horizon and locality, are referable to the species. No. 16111, a jaw fragment from the lower Sand Coulée horizon in Clark Fork Basin, is smaller and perhaps a primitive mutant.

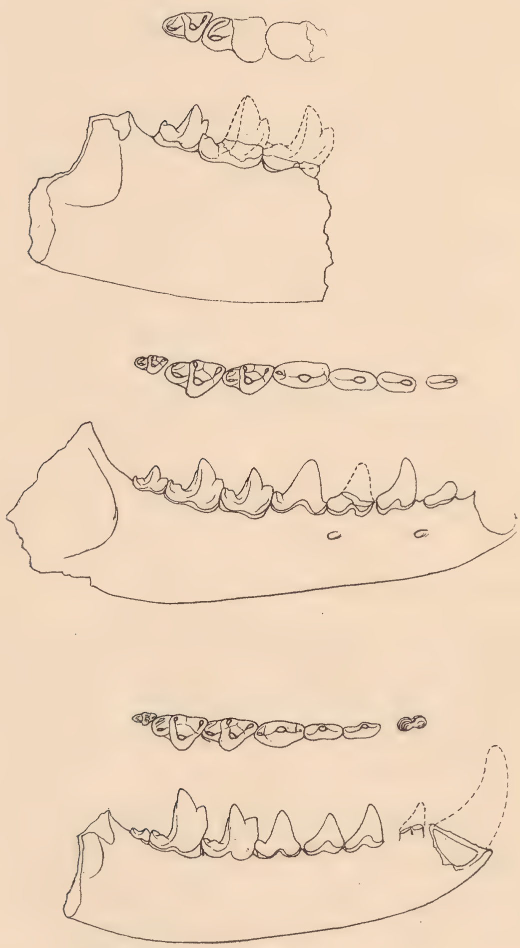

Fig. 57.

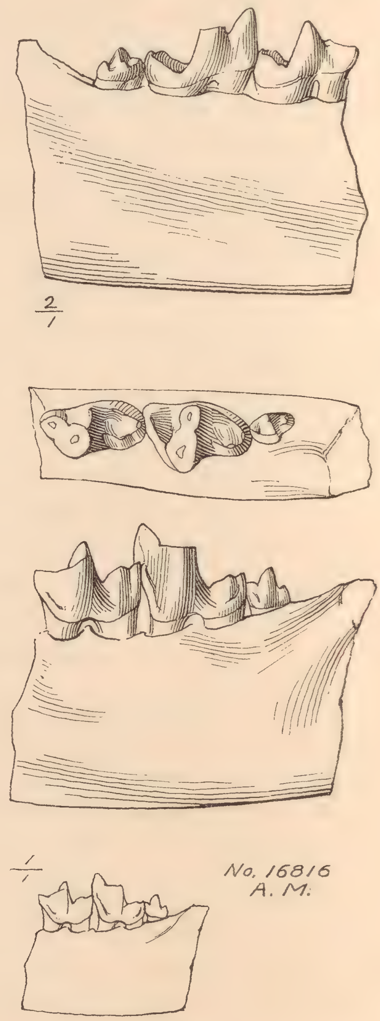

Fig. 58.

Fig. 57. *Prolimnocyon*, lower jaws, natural size, from Gray Bull beds of Big Horn Basin. Upper figure is No. 15168, type of *P. robustus;* the two lower Nos. 15166, 15172, referred to *P. atavus*, but doubtfully cospecific.

Fig. 58. *Prolimnocyon atavus*, part of lower jaw with m_{1-3} inner, superior and outer views, enlarged to two diameters, with outline of natural size. From the type specimen No. 16816, Gray Bull beds, Big Horn Basin.

The molar and premolar teeth are much as in *Thinocyon*. P_4 has a strong anterior basal cusp, the anterior premolars are rather short and high; p_2 has roots connate. The heels of the molars are also like those of *Thinocyon,* compressed, narrow and bordered by two subequal crests. In most species of *Sinopa* the heels are relatively broader and usually larger; but I can find no constant generic distinctions in the construction of the molars.

Upper and lower teeth of the same individual are preserved in Nos. 15240 and 15246, and No. 15171, a crushed and imperfect skull, shows the upper teeth and a few cranial characters of interest. The remainder of the speci-

Fig. 59.

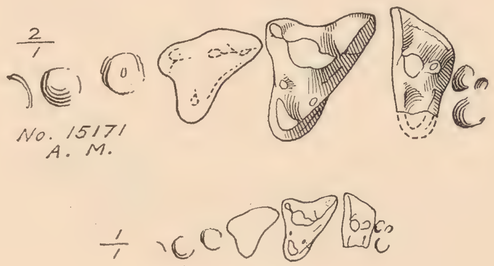

Fig. 60.

Fig. 59. *Prolimnocyon atavus,* calcaneum of type specimen, natural size, dorsal view.
Fig. 60. *Prolimnocyon atavus,* upper teeth, from skull No. 15171, crown view, enlarged to two diameters and natural size. The outline of p^4 is taken from No. 15246. Gray Bull beds, Big Horn Basin.

mens are all lower jaws, fragments of the skeleton being associated with the type only.

In the skull, m^2 is transverse, nearly as wide as m^1, the metacone vestigial, parastyle long and curved. M^3 is represented by two alveoli which indicate a tooth one-half or one-third the transverse width of m^2. M^1 is much like the corresponding tooth in *Sinopa,* but with *me* and *pa* more closely connate. P^4 is 3-rooted triangular, smaller than m^1; p^3 has also a small internal root. The skull is too poorly preserved to show many important data; the interorbital width is large, as in Limnocyoninæ, without the frontal fossa characteristic of Hyænodonts; the occiput is broad, and the general proportions agree fairly well with *Thinocyon.*

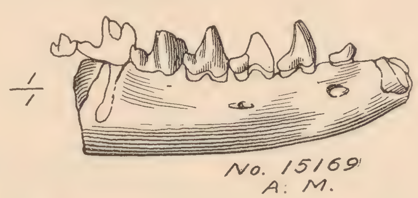

Fig. 61. *Prolimnocyon atavus,* lower jaw, outer view, natural size. No. 15169; outlines of p_3 and m_{2-3} restored from Nos. 15246, 16816. Gray Bull beds, Elk Creek, Big Horn Basin, Wyoming.

The sacrum is narrow, although wider than in *Thinocyon;* the sacral ribs are much narrower than in *Sinopa* or *Tritemnodon.* The anterior zygapophyses on the first sacral vertebra are nearly flat; in *Thinocyon* they are considerably more concave, in *Tritemnodon* they are about semi-cylindrical. The head of the tibia shows a low cnemial crest. The calcaneum has a rather short tuber, a small fibular facet, moderate peroneal process, cuboid facet nearly as wide as it is deep, and moderately oblique.

Prolimnocyon robustus sp. nov.

A considerably larger species is indicated by a part of a lower jaw, No.

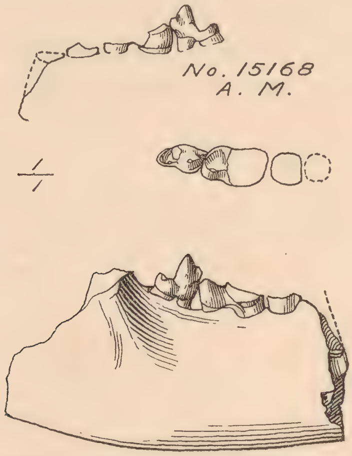

Fig. 62. *Prolimnocyon robustus*, lower jaw fragment, type specimen, external view with crown and inner views of teeth, all natural size. Lower Gray Bull beds, Big Horn Basin.

15168, from the Big Horn Basin, Gray Bull beds. The larger size, deeper jaw, less relative reduction of m_3 indicate its distinctness.

Prolimnocyon antiquus sp. nov.

Type, No. 14768, lower jaw with teeth mostly broken off, from the Lost Cabin horizon in the Wind River Basin.

Distinctive Characters: Size of *P. atavus* or slightly larger; m_3 one-rooted.

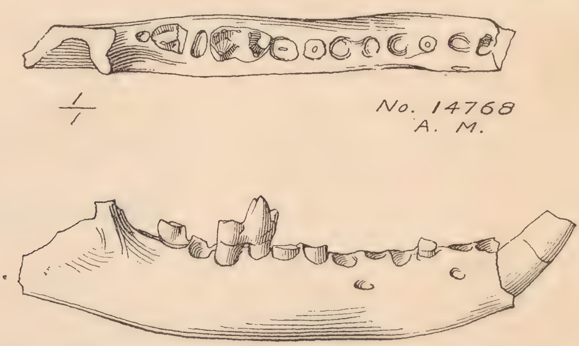

Fig. 63. *Prolimnocyon antiquus*, lower jaw, superior and external views, natural size. Type specimen, Lost Cabin beds, Wind River Basin.

This species is represented only by the type and doubtfully by No. 2971, but the small round alveolus for m_3 is so clearly distinct from anything in the Gray Bull horizon that I do not doubt its validity. The second specimen shows the unworn premolars and m_1, very similar in characters to those of *Thinocyon*, but in absence of the posterior molars it is not certainly determinate.

A fourth species, which I have placed under *Sinopa* (*S. mordax*) is undoubtedly related to this genus, and when better known may have to be transferred to it. It shows several characteristic Oxyænid features, but m_3 is only a little smaller than m_2 and has a well developed metaconid.

HYÆNODONTIDÆ.

Sinopa (*Stypolophus*) is perhaps the most abundant Creodont genus in the Lower Eocene and practically the only representative of the family at this time. The more specialized *Tritemnodon* is first represented in the Lost Cabin beds by a marginal species, *T. whitiæ*, retaining several characters of *Sinopa*. The hyænodonts of the Lower Eocene evidently approach the Oxyænidæ, the two groups being derivable from a common source. This is especially seen in the two-rooted p_1, of several of the species, and in the heavy jaw and *Limnocyon*-like premolars of *S. mordax*.

Sinopa *Leidy.*

The Lower Eocene species of this genus were revised by Matthew in 1901 chiefly on the basis of Wyoming specimens. The new collections from New Mexico and Wyoming have supplied a large series of specimens for comparison. These serve to modify the earlier conclusions in some degree.

The species are for the most part not very sharply distinguished from each other or from those of the Bridger horizons.

Three new species are here described, and all but one of the described species of the Lower Eocene are validated or confirmed by reference to them of additional and more complete specimens, topotypes where possible. I must confess some doubt however, as to whether all the forms here described are entitled to specific rank on the standards used in this revision; or on the other hand whether some may not include two or more species which more complete material would show to be distinct. It is also possible that more than one genus is included. *Prototomus* Cope 1874, may have to be revived to include *S. viverrina* and probably *S. ? secundaria* when these species are better known. Professor Scott in his recent book appears disposed to revive *Stypolophus* (type *S. pungens*) and include in it all the Lower Eocene species, limiting *Sinopa* to the middle Eocene. He gives no hint of reason for this procedure, nor am I able to imagine any justification for it. The Lower Eocene species are distinguished from their successors by a number of skull and skeleton differences which might conceivably be regarded as generic, although I do not regard them as such. But the name *Stypolophus* could not be used for them, as its type species is middle Eocene, and closely allied to *S. rapax*, type of *Sinopa*.

Key to Species of Sinopa.

I. Heels of m_{1-2} broad-basined, equalling trigonid in diameter. *Pa* and *me* of m^{1-2} well separated. Premolars robust with rugose enamel, p_1 one-rooted.
- A. Molar shears of similar type, heel of m_3 broad, *me* of m^3 well developed.
  - a. Trigonids of molars robust, not high.
    - 1. $M_{1-3} = 29$; no diastema behind p_2 .... *S. major.*
  - b. Trigonids of molars of moderate height.
    - 2. $M_{1-3} = 26$ mm.; a diastema behind p_2 .... *S. grangeri.*
    - 3. $M_{1-3} = 28$ mm.; no diastema behind p_2 .... *S. shoshoniensis.*
    - 4. $M_{1-3} = 25$ mm.; " " " " .... *S. rapax.*
    - 5. $M_{1-3} = 20$ mm.; " " " " .... *S. pungens.*
- B. Carnassials, $\frac{m^2}{m_3}$, more specialized with shear more anteroposterior; anterior molars with shears little developed. Heel of m_3 narrow, metacone of m^3 vestigial.
    - 6. $M_{1-3} = 31$ mm. .... *S. opisthotoma.*

II. Heels of m_{1-3} narrow-basined; trigonids high, and broader than heels. *Pa* and *me* of upper molars more connate. Premolars higher with smooth enamel, p_1 two-rooted, compressed.
    - 7. $M_{1-3} = 29$ mm.; diastema behind p_2 .... *S. hians.*
    - 8. $M_{1-3} = 25$–26 mm.; no diastema behind p_2 .... *S. strenua.*

III. Smaller species of intermediate type, but nearer to division ii.
    - 9. $M_{1-3} = 21.5$ mm.; premolars more robust, symphyseal region shorter and deeper, $m\frac{1}{1}$ less reduced .... *S. multicuspis.*
    - 10. $M_{1-3} = 20$–22 mm.; premolars and molars narrower and more compressed, symphyseal region shallow and elongate, $m\frac{1}{1}$ more reduced .... *S. vulpecula.*
    - 11. $M_{1-3} = 17$ mm.; premolars with slender acute cusps, a considerable diastema behind p_2 .... *S. ?secundaria.*
    - 12. $M_{1-3} = 18.7$ mm.; heels larger than in the three preceding species. *S. minor.*
    - 13. $M^{1-3} = 14$ mm., smaller than any preceding...... *S. viverrina.*

IV. Jaw heavy, symphyseal region massive, symphysis close, premolar construction approaching Limnocyoninæ.
    - 14. $M_{1-3} = 21$ mm.; m_3 somewhat reduced .... *S. mordax.*

Sinopa mordax sp. nov.

Type, No. 16157, lower jaws, from the Gray Bull horizon, Clark Fork Basin, Wyoming.

Distinctive characters: M_3 smaller than m_1 and slightly smaller than m_2; p_4 with strong anterior basal cusp; canine stout with massive root; jaw thick and heavy especially at symphysis. $M_{1-3} = 22$ mm.

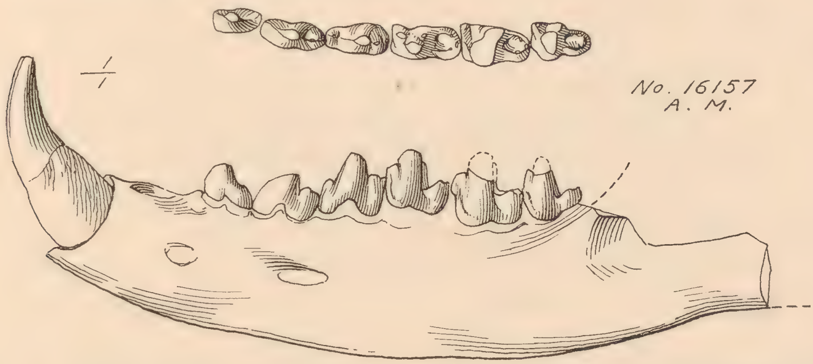

Fig. 64. *Sinopa mordax*, lower jaw, type specimen, natural size, outer view and crown view of teeth. Gray Bull beds, Clark Fork Basin.

The characters of this species show a marked approximation to the Oxyænidæ, and especially to *Prolimnocyon*. It serves to emphasize further the near approximation of Oxyænidæ and Hyænodontidæ in the lower stages of the Wasatch.

Sinopa opisthotoma *Matthew* 1901.

Sinopa opisthotoma MATTHEW 1901, Bull. A. M. N. H., Vol. XIV, p. 28, fig. 9.

Type, A. M. No. 99, upper and lower jaws from the Wasatch of the Big Horn Basin, Wyoming, probably Gray Bull horizon.

Distinctive characters: $M_{1-3} = 31$ mm.; m^2 and m_3 relatively large with shear more antero-posterior than in other species. Lower premolars without anterior basal cusps; posteroexternal cusps of upper premolars weak or absent. The enamel of premolars and molars is rugulose with anastomosing vertical ridges.

Pa. and *me* well separated on m^1 and m^2, heels of m_{1-2} broad basined; a small *me* on m^3, heel of m_3 narrow and elongate.

Thirteen specimens from the Gray Bull Wasatch of the Big Horn Basin are referable to this species. It is about as large as *S. hians,* but of very distinct type.

Sinopa shoshoniensis sp. nov.

Type, No. 16158, a lower jaw from the Gray Bull beds of Clark Fork Basin, Wyoming. Paratype, No. 15745, lower jaws and fragments of upper jaws, from lower

Gray Bull Beds, Big Horn Basin. Nos. 15742, 15515, 15734, 15743, lower jaws, and three unnumbered jaws from the Shoshone River in the Big Horn Basin are referred to this species.

Distinctive characters: Slightly smaller than *hians* and *opisthotoma*. Heels of all lower molars large. Surface of enamel rugose striated vertically, canines heavily

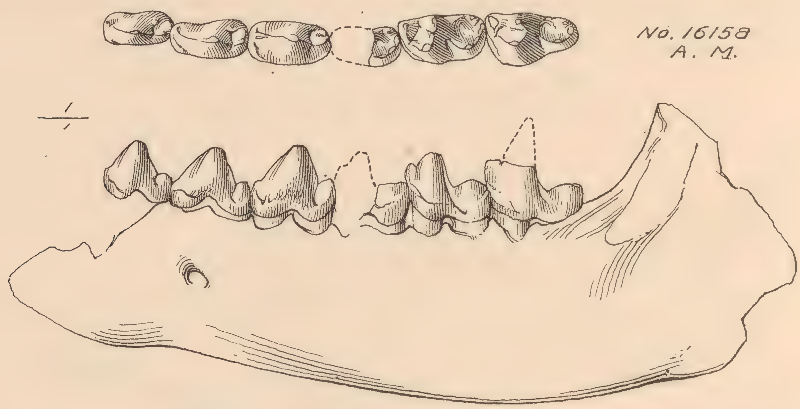

Fig. 65. *Sinopa shoshoniensis*, lower jaw, type specimen, natural size, outer view and crown view of teeth. Gray Bull beds, Clark Fork Basin, Wyoming.

grooved. Premolars robust without anterior basal cusps. Heel of last lower molar broader and shear of trigonid more transverse than in *opisthotoma*. M^2 nearly as large as m^1, p^3 with strong inner cusp. Posteroexternal cusps of pms small, anteroexternal rudimentary.

This species is nearly related to *opisthotoma*, but distinguished by the typical proportions of the molar shears; it is evidently allied to the typical group of *Sinopa* (*S. rapax, pungens* and *grangeri*) of the Middle Eocene, and may well be ancestral to it.

Sinopa strenua (*Cope* 1875).

Prototomus strenuus Cope, 1875, Syst. Cat. Eoc. Vert. New Mex., p. 10; (*Stypolophus*), 1877, Ext. Vert. New Mex., p. 117, pl. xxxix, fig. 11; (*Sinopa*) Matthew 1901, Bull. A. M. N. H., Vol. XIV, p. 26.

Sinopa hians (Cope), Matthew 1901 l. c. Not *Stypolophus hians* of Cope.

Type, U. S. Nat. Mus. No. 1023, lower jaws with p_4–m_3 r. and l., much damaged and buried in matrix.

Distinctive characters: m^{1-3} = 22 mm.; m_{1-3} = 24–26 mm.; heels of molars small, trigonids high; jaw long and slender anteriorly, p_1 two-rooted, p_2 not spaced. Enamel smooth.

A number of specimens from the Gray Bull horizon of the Big Horn Wasatch agree fairly well with the type of *S. strenua*. No. 15234, anterior half of skull and lower jaws, and No. 2850 upper and lower jaws with fragments of skull and skeleton show the dentition well preserved. The species appears to be related through *S. hians* and *T. whitiæ* to the *Tritemnodons* of the Bridger formation.

Nos. 4782, 14773–5, upper and lower jaws from the Lost Cabin horizon

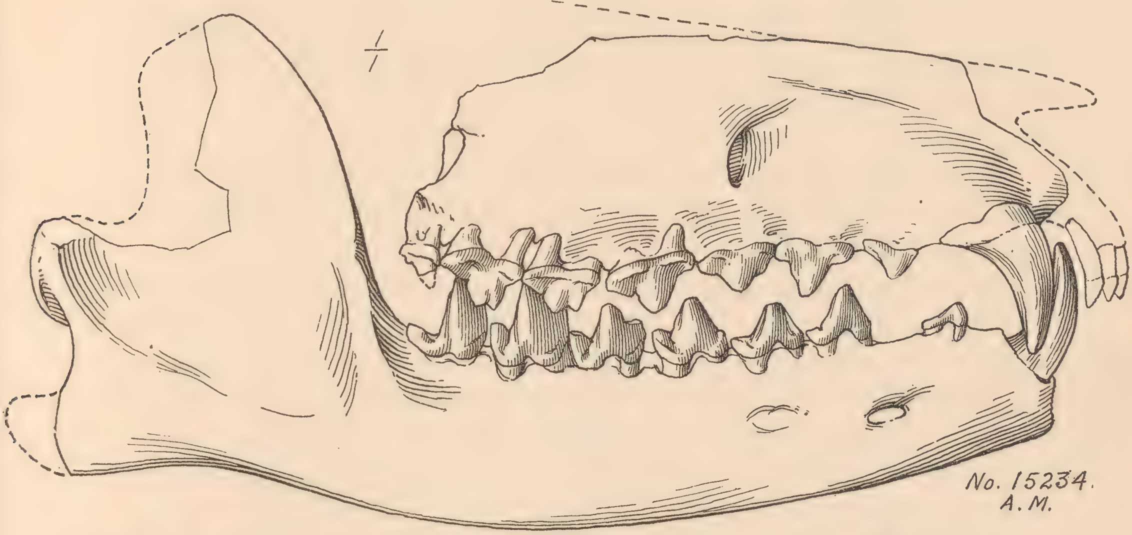

Fig. 66. *Sinopa strenua*, front of skull and lower jaw, natural size. No. 15234, upper Gray Bull beds, Big Horn Basin.

of the Wind River, agree in most respects with the Gray Bull specimens and with the type of the species, but are somewhat smaller and the metacone of m^3 vestigial while it is distinct in the Gray Bull form.

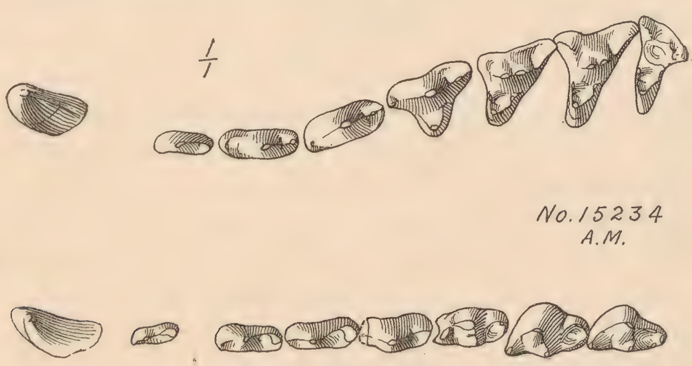

Fig. 67. *Sinopa strenua*, upper and lower dentition, crown views, natural size. From No. 15234.

Sinopa hians (*Cope* 1877).

Stypolophus hians Cope 1877, Ext. Vert. New Mex., p. 72, pl. xxxviii, figs. 12–30; (*Sinopa*) Matthew 1901, Bull. A. M. N. H., Vol. XIV, p. 25 (in part).

Type, U. S. Nat. Mus. No. 1111, numerous fragments of skeleton in bad preservation.

Distinctive characters: $m^{1-3} = 25$, $m_{1-3} = 29$ mm.; heels of molars small, trigonids high, enamel nearly smooth, jaw long anteriorly deeper and more massive than in *S. strenua*, p_1 two-rooted, p_2 spaced, p_{3-4} with distinct anterior basal cusps, molars increasing but little from m_1 to m_3. Posteroexternal cusps of p^3 and p^4 strong, antero-external cusps minute or absent. Metastyle of m^1 moderately extended; m^2 wide transversely, its antero-posterior diameter comparatively small, *pr* and *me* of equal height and rather closely connate, *ps* and *ms* subequal, extending more externally than in other species. Parastyle of m^3 much extended externally, paracone high, metacone almost vestigial.

This species is close to *T. whitiæ* on the one hand, to *S. strenua* on the other, representing an intermediate stage in character of teeth, but larger than either species.

No. 16214, lower jaws and fragments of the skeleton from the top of the Almagre horizon of the New Mexican Wasatch agrees fairly well with the fragmentary jaws of the type specimen, and is taken as a topotype. No. 16821, upper and lower jaws with parts of skull and skeleton from the upper level of the Gray Bull horizon of the Big Horn Wasatch, agrees with the topotype. The distinctive characters above noted are chiefly based on these two specimens, the type having no teeth preserved.

No. 12776, upper and lower jaws from the Lost Cabin beds in the Wind River Basin is also referred here.

A comparison of No. 16821 with *Tritemnodon agilis* shows a close agreement in details of skeleton construction, so far as comparison can be made, but the Wasatch species is more primitive in the following particulars.

The astragalar trochlea is less grooved, its inner crest less defined, and it is more limited posteriorly, the astragalar foramen more distinct. The head of the astragalus is wider and of somewhat less depth. The astragalo-calcanear facet is wider. The calcaneo-cuboid facet is wider; the calcaneo-fibular facet less extended backwards, the tuber calcis somewhat heavier. The astragalar facet of the tibia is somewhat flatter and more oblique, the internal malleolus has a more prominent posterior tuber and less prominent anterior crest. The third trochanter of the femur is considerably further down upon the shaft. The skull and jaws are more robustly proportioned, with a remarkably long sagittal crest great overhang to the occiput, long postorbital region and contracted brain-case. We have no good skull of *T. agilis* in the collection, but *S. hians* differs in these skull features from *T. whitiæ* and more markedly from Wortman's reconstruction of *T. agilis* or from *Sinopa grangeri* of the Bridger.

The above specified differences also separate *S. hians* from the Middle Eocene species of *Sinopa* (*S. rapax, grangeri*). It appears therefore that the evolution of the Hyænodonts from Lower to Middle Eocene was in part parallel progressive.

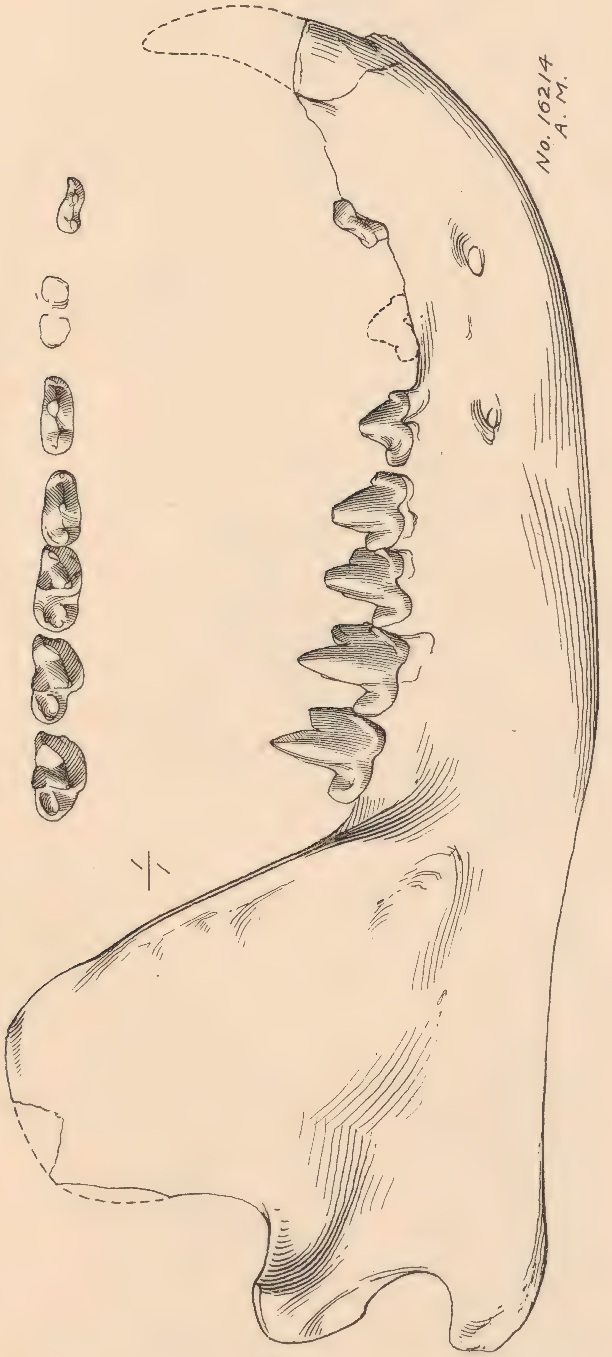

Fig. 68. *Sinopa hians*, lower jaw, outer view and crown view of teeth, natural size. No. 16214. topotype, top of Almagre beds, Wasatch of San Juan Basin, New Mexico.

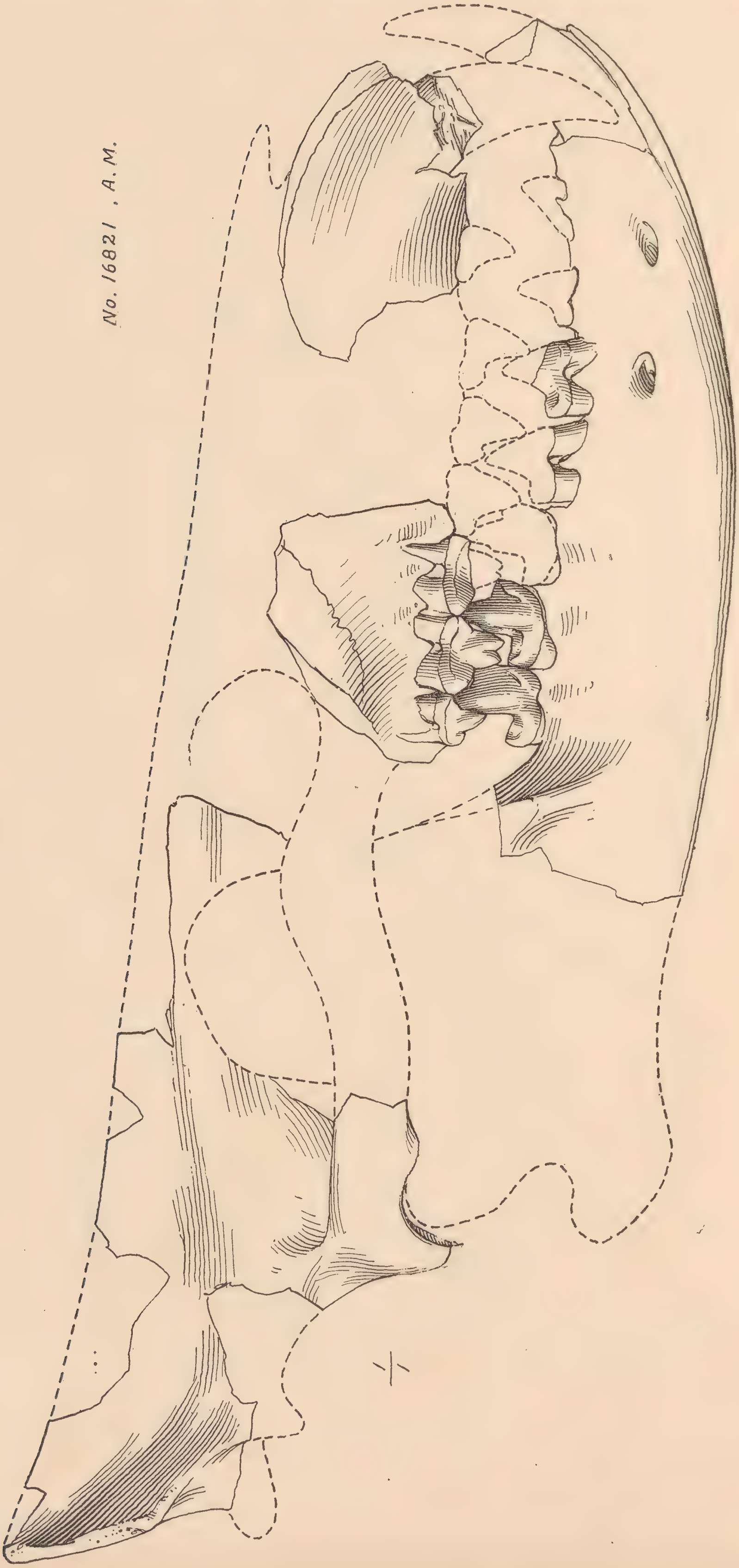

Fig. 69. *Sinopa hians*, reconstruction of skull and lower jaws, natural size, from fragmentary skeleton No. 16821. Upper Gray Bull beds, Big Horn Basin.

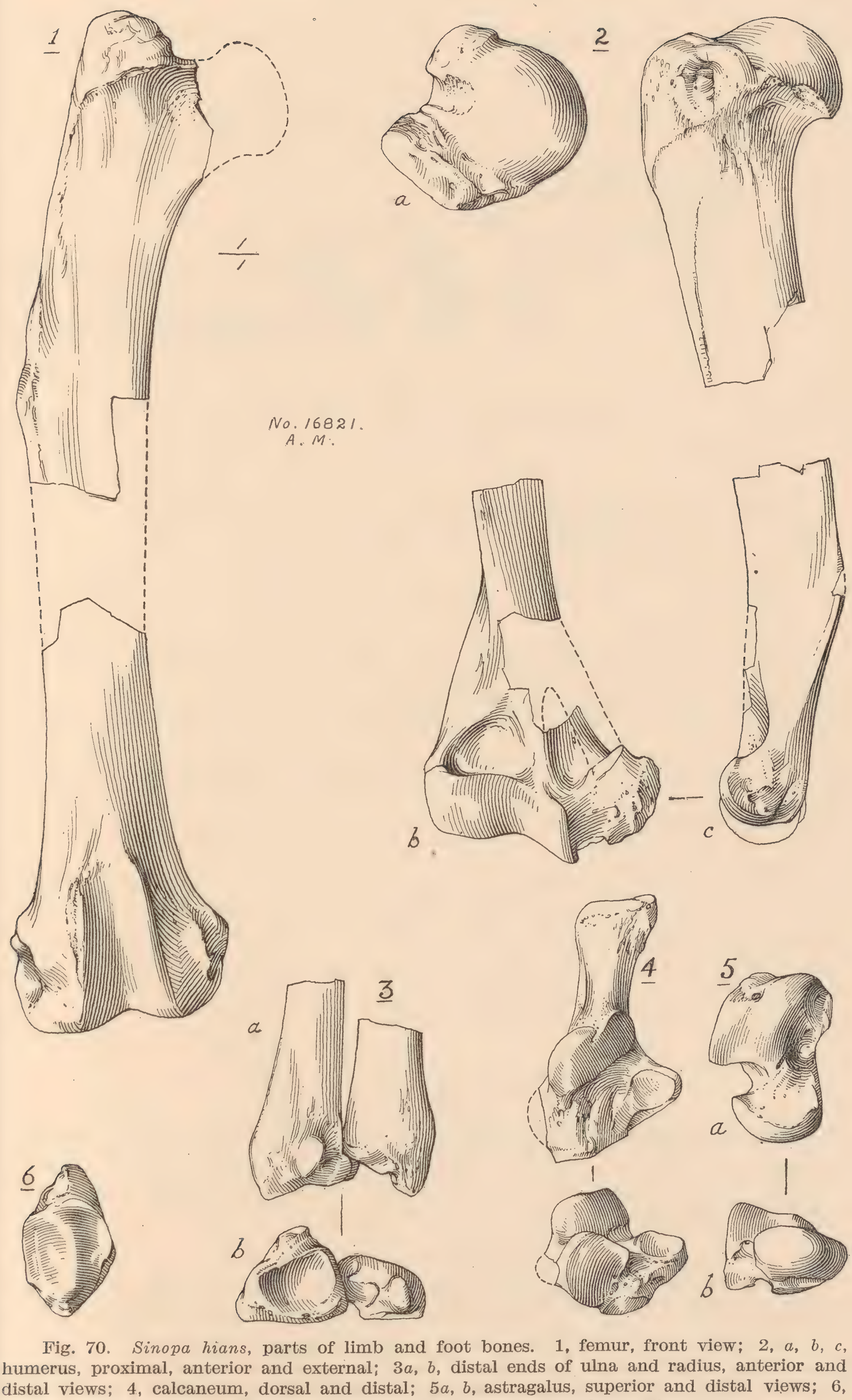

Fig. 70. *Sinopa hians*, parts of limb and foot bones. 1, femur, front view; 2, *a*, *b*, *c*, humerus, proximal, anterior and external; 3*a*, *b*, distal ends of ulna and radius, anterior and distal views; 4, calcaneum, dorsal and distal; 5*a*, *b*, astragalus, superior and distal views; 6, patella, posterior view. All natural size, from the fragmentary skeleton, No. 16821.

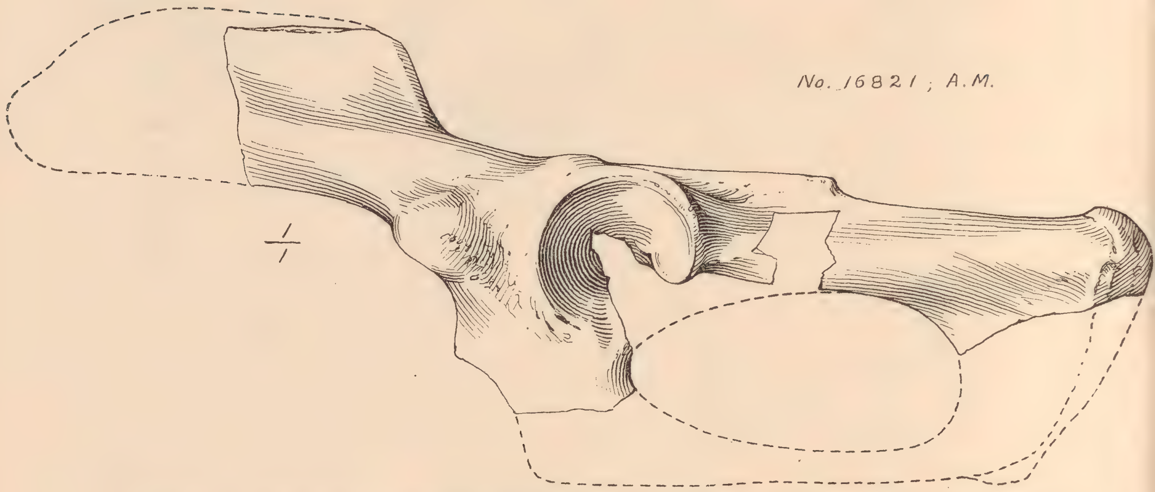

Fig. 71. *Sinopa hians*, pelvis of fragmentary skeleton No. 16821, natural size, left side view.

Sinopa multicuspis (*Cope* 1875).

Prototomus multicuspis Cope, 1875, Syst. Cat. Vert. Eoc. New Mex., p. 10; (*Stypolophus*), 1877, Ext. Vert. New Mex., p. 116, pl. xxxix, figs. 12–14; (*Sinopa*), Matthew 1901, Bull. A. M. N. H., Vol. XIV, p. 27.

Type, U. S. Nat. Mus. No. 1021, upper jaw, p^4–m^3 from the New Mexican Wasatch.

Distinctive characters: $M^{1-3} = 19$ mm.; $m_{1-3} = 21$ mm. Jaw rather short, premolars all two-rooted, p_2 spaced. Enamel smooth, molars subequal in size, heels rather small. A deuterocone on p^3.

To this species are referred a number of upper and lower jaws from the Lost Cabin, Lysite and Gray Bull horizons, Nos. 4782, 14773–5 from Lost Cabin zone, 16819–20 from upper Gray Bull or Lysite, 15239, 16156, from Gray Bull zone. In No. 16820 numerous fragments of the skeleton are associated with the upper and lower jaws.

Sinopa vulpecula sp. nov.

Type, No. 15606, lower jaw from Lost Cabin horizon in Big Horn Basin, Wyoming.

Distinctive characters: Size of *S. multicuspis*, but $m\frac{1}{1}$ relatively small, premolars higher, more compressed, accessory cusps smaller, jaw slender and elongate anteriorly with considerable diastemata before and behind p_1.

Nos. 15744, lower jaws, and 73, upper jaw fragment with m^{1-2}, both from the top of the Gray Bull beds in the Big Horn Basin supplement the

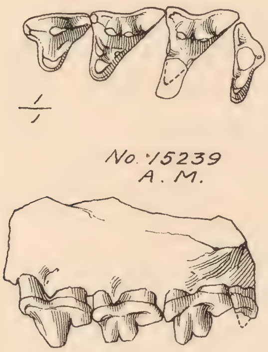

Fig. 72.

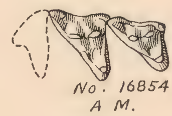

Fig. 74.

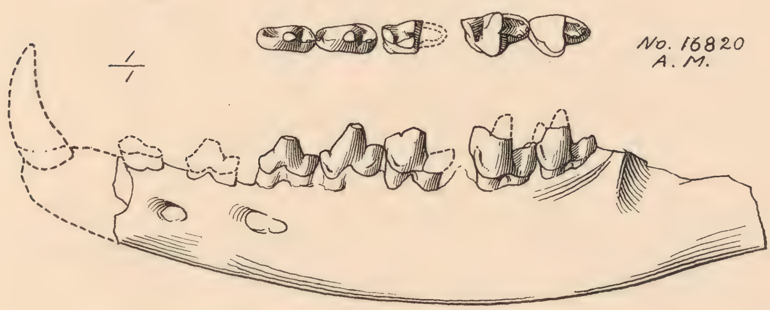

Fig. 73.

Fig. 72. *Sinopa multicuspis*, upper jaw, outer view, and crown view of teeth, natural size. No. 15239, lower Gray Bull beds, Big Horn Basin. The third molar is completed from another individual.

Fig. 73. *Sinopa multicuspis*. Lower jaw, outer view, and crown view of teeth, natural size. From fragmentary skeleton No. 16820, upper Gray Bull or Lysite beds, Big Horn Basin.

Fig. 74. *Sinopa ? vulpecula*, upper teeth, natural size, crown view, No. 16854, Lysite beds, Big Horn Basin.

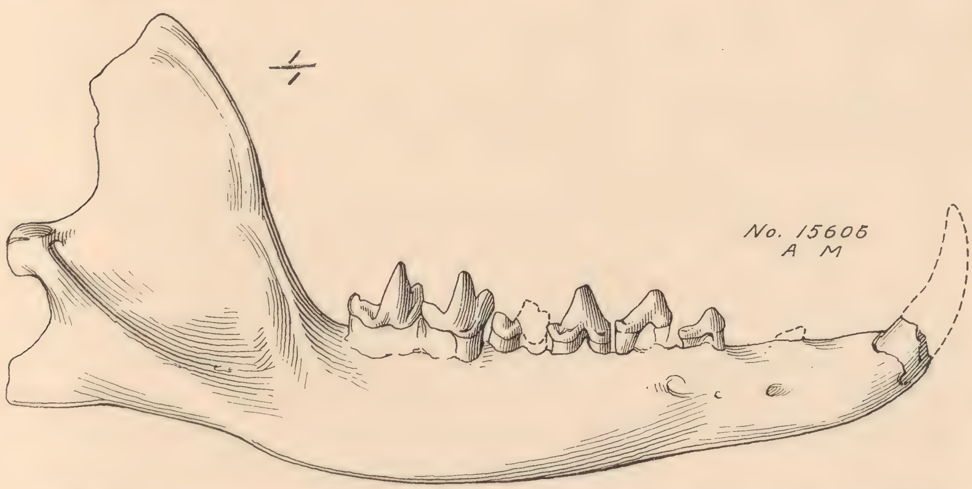

Fig. 75. *Sinopa vulpecula*, lower jaw, external view natural size. No. 15606, type specimen. Lost Cabin horizon, Big Horn Basin. Found in association with type of *Oxyæna pardalis*.

characters of the type; a number of more or less fragmentary jaws are referable to this species, but add little or nothing to the stated characters. The species evidently belongs to the *strenua* group and is closely allied to *S. multicuspis.*

Fig. 76. *Sinopa vulpecula,* lower jaw, outer view, and crown view of p_4–m_1, natural size. No. 15744, top of Gray Bull beds, Big Horn Basin.

Sinopa secundaria (*Cope* 1875).

Prototomus secundarius Cope, 1875, Syst. Cat. Vert. Eoc. New Mex., p. 9; (*Stypolophus*) 1877, Ext. Vert. New Mex., p. 115. Not figured.

Type, U. S. Nat. Mus. No. 1025, two fragments of lower jaw preserving the heels of p_4 and m_2, and other associated fragments of bones, from the Wasatch of New Mexico.

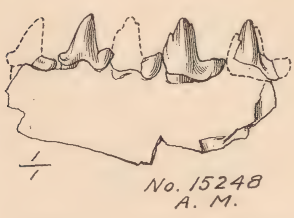

Fig. 77. *Sinopa* cf. *secundaria,* lower jaw fragment, external view, natural size, with molars and last two premolars more or less broken. Upper Gray Bull beds, Big Horn Basin.

The type is practically indeterminate. It appears to be smaller than *S. multicuspis* and *vulpecula.* There is some evidence of a species in the Big Horn Basin of about this size, and distinguished by the peculiarly acute high pointed premolars and the considerable diastema behind p_2. No. 15248 from the upper Gray Bull, parts of the jaws with p_3–m_3 more or less broken, and other less distinctive specimens of jaws, etc., may be compared with *S. secundaria,* although too fragmentary for definite reference.

Sinopa viverrina *Cope* 1874.

Prototomus viverrinus Cope 1874, Rep. Foss. Vert. New Mex., p. 13; 1875, Syst. Cat. Vert. Eoc. New Mex., p. 9; (*Stypolophus*) 1877, Ext. Vert. New Mex., p. 112, pl. xxxviii, figs. 1–11; (*Sinopa*) Matthew 1901, Bull. A. M. N. H., Vol. XIV, p. 27.

Type, U. S. Nat. Mus. No. 1022, palate and fragments of skeleton from the New Mexican Wasatch.

Distinctive characters: M^{1-3} = 14 mm. No deuterocone on p^3; deuterocone of p^4 small, submedian.

This species does not appear to be represented in our collections. Two or three fragments of lower jaws formerly thought to belong to it are now known to be *Prolimnocyon*. It is clearly distinguished from all the larger species by the characters of the premolars, which are suggestive of the smaller Limnocyoninæ.

Sinopa, sp. incert.

A number of specimens are not satisfactorily referable to any of the above described forms, but they are too incomplete for diagnosis of new species.

Two lower jaws from the Sand Coulée beds are about the size of *S. ?secundaria*, but do not agree very closely in other respects either with it or with each other. The same is true of several fragments of jaws from the Gray Bull horizon.

Geological Range of Lower Eocene Species of Sinopa and Tritemnodon.

	Clark Fork		Big Horn			Wind R.		New Mex.	
	Sand Coulée	Gray Bull	Gray Bull	Lysite	Lost Cabin	Lysite	Lost Cabin	Lower	Upper
hians				*		*			*
strenua			*	*		?	*	?	
whitiae					?		*		
opisthotoma			*						
shoshoniensis		*	*						
multicuspis				* *	?			?	
viverrina								?	
mordax		*							
vulpecula				*	*				
secundaria			*						*
sp. indet.	*								

Tritemnodon whitiæ (*Cope* 1882).

Stypolophus strenuus Cope 1881, Bull. Hayd. Sur. No. VI, p. 192 (not *S. strenuus* Cope 1874); *S. whitiæ* Cope 1882, Proc. Am. Phil. Soc., Vol. XX, p. 161; Tertiary Vertebrata, p. 292, pl. xxvb, figs. 8–14.

Distinctive characters: $M_{1-3} = 22.5$; molars compressed, with small heels, enamel smooth; no metacone on m^3; small inner heel on p^3.

Type, A. M. No. 4781 lower jaw and part of skeleton from the Lost Cabin horizon of the Wind River Basin.

A partial skull and lower jaws No. 4782 from the same horizon and locality has been fully described and figured by Cope. I have seen no additional specimens positively referable. It is approximately intermediate in tooth characters between *S. hians* of the Lysite and *T. agilis* of the Lower Bridger, although smaller in size than either.

MESONYCHIDÆ.

This family is typically represented in the Lower Eocene by the genus *Pachyæna* which includes a number of larger and smaller species, and is fairly common. The Paleocene genus *Dissacus* also survives into the Gray Bull horizon, and the peculiar little *Hapalodectes* occurs in the Lysite and Lost Cabin levels.

In discussing the Bridger Mesonychidæ in 1909, the writer pointed out their aberrant character among Creodonta and resemblances to Artiodactyla which ought not to be hastily attributed to parallelism. This and other considerations have led Dr. Gregory to view the Artiodactyls as derivatives of some ancient Creodonta near the Mesonychidæ. The skeleton characters of *Dissacus* and *Pachyæna* do not however, lend much support to the argument for this view. *Pachyæna* shows the artiodactyloid characters in a diminished degree, *Dissacus* still less. The skeleton of *Triisodon* is hardly known, but there is a very considerable gap between it and *Dissacus* in the construction of the teeth — partly bridged by *Microclænodon.* If all these genera are to be included in the one family, it must be regarded as one of very ancient differentiation, but its abnormal characters (for a Creodont) appear to be all adaptive to some peculiar mode of life.

I may repeat that the alleged carrion-eating habits[1] are not at all indi-

[1] Scott, 1913, Land Mammals of the Western Hemisphere, pp. 560–561. Exception must also be taken to Professor Scott's statements that *Pachyæna* "retained the epicondylar foramen of the humerus and pentadactyl feet" and that *Dissacus* had sharp claws. It is also doubtful whether the typical species of *Dissacus* had five functional digits.

cated by the adaptive features of the teeth. The cusps are blunt-pointed and were subjected to an extreme degree of wear by the nature of the food; but the long slender and rather weak jaw is quite unsuited to crushing bones, and the entire lack of shearing teeth is equally unsuited to cutting flesh or tendons. The hyæna, usually regarded as a typical carrion-eater, has teeth of wholly different character, paralleled by *Patriofelis* among the Creodonts. The Mesonychid teeth may perhaps have been adapted to crushing fresh-water molluscs or some similar food that would involve a great deal of wear of the cusps without entailing any great strength of jaw. They certainly are not suited either for bone-crushing or flesh-cutting, nor do they appear suitable for omnivorous or frugivorous habits; they are neither pig-like nor bear-like, and the hoof-like claws are not consonant with digging nor the snout with rooting habits.

I do not know of any parallel adaptation among modern mammals, but the Fayum *Apterodon* shows a notable approach to the Mesonychid style of teeth. In this genus, however, if Andrews's association of the skeletal parts be correct, the limbs indicate some degree of natatorial adaptation, while in the Mesonychidæ the adaptation appears to be progressively cursorial. This is not inconsistent with the suggestion of feeding on fresh water molluscs; the Mesonychidæ show the cursorial adaptation only in the smaller phyla, which would presumably be inoffensive animals requiring means of escape from carnivorous enemies, while *Apterodon* if of similar food adaptation might readily become aquatic.

Key to Genera of Mesonychidæ.

A. Molars $\frac{3}{3}$; metaconids well developed, paraconids smaller, especially on p_4 and m_3; pollex complete in *D. saurognathus* . . . . *Dissacus.*

B. Molars $\frac{3}{3}$; metaconids vestigial; paraconids large on p_4–m_3; pollex vestigial. *Pachyæna.*

C. Metaconids absent, paraconids large on p_4–m_3.
   1. Molars $\frac{3}{3}$; limbs and feet slender, pollex vestigial . . . . *Synoplotherium.*
   2. Molars $\frac{2}{3}$; limbs and feet very slender, pollex vestigial or absent . . . . *Mesonyx.*
   3. Molars $\frac{2}{3}$; limbs and feet short robust, pollex unknown . . . . *Harpagolestes.*

D. Molars $\frac{3}{3}$; metaconids small, paraconids large on m_{1-3} teeth highly compressed; skull and skeleton unknown . . . . *Hapalodectes.*

Dissacus *Cope* 1881.[1]

Type, *D. navajovius* from the Torrejon of New Mexico.

Generic distinctions: Metaconids distinct on m_{1-3}; paraconids weaker especially on m_3; pollex (?) complete; humerus with entepicondylar foramen.

[1] Amer. Nat., Vol. XV, p. 1018.

This genus is characteristic of the *Torrejon,* where it is represented by two species, *D. navajovius* Cope and *saurognathus* Wortman. A third species, *D. europæus,* is recorded from the Cernaysien of France. A small species from the Wasatch was referred to the genus by Osborn and Wortman in 1892, but Matthew in 1909 separated it as a distinct genus *Hapalodectes.* True *Dissacus* does, however, appear to be represented by three specimens from the northern Wasatch, one from the Clark Fork, two from the Gray Bull beds. The first represents an undescribed species, the others I cannot separate by any specific distinctions from *D. navajovius* of the Torrejon.

The European species, *Plesidissacus europæus* Lemoine, was refigured by Boule in 1903 and referred to Cope's genus. The type is part of a lower jaw with p_4–m_2, and agrees with *D. navajovius* in size and such characters as can be observed in the figure. It is retained as a distinct species upon Boule's authority.

Key to Species of Dissacus.

A. Larger species with robust molars, massive jaw, powerful canines and heavy jaw condyles. Limbs robust, feet spreading, pollex complete.
   1. M_{1-3} = 57 mm.; paraconids large on p_4–m_2; m_1 smaller than m_2; m_3 with small paraconid and reduced heel .... *D. saurognathus.*

B. Smaller species with more compressed molars, canines and jaw condyles smaller and jaw more slender. Limbs slender, feet compressed.
   2. m_{1-3} = 33 mm., paraconids small on all teeth; m_1 smaller than m_2, heel of m_3 long .... *D. navajovius.*
   3. M_{1-3} = 38 mm., paraconids somewhat larger, m_1 as large as m_2, heel of m_3 reduced .... *D. navajovius longævus.*
   4. Molars intermediate in size between *D. navajovius* and *saurognathus,* paraconids more reduced than in either, metacone of m_3 vestigial. *D. prænuntius.*

Dissacus navajovius longævus mut. nov.

Type, 15732, a lower jaw with p_4–m_3, from the Gray Bull beds of Shoshone River in the Big Horn Basin.

Distinctive characters: M_{1-3} = 38 mm., m_1 as large as m_2, m_3 smaller with reduced heel, paraconids larger than in *D. navajovius.*

The type consists of a nearly complete left ramus. A second specimen, No. 15229, comprises parts of the lower jaws of a young individual with milk premolars and m_{1-2}. On account of the individual variation among specimens from the Torrejon referred to *D. navajovius,* I regard this as representing rather a progressive mutant than a distinct species. Although the metaconid is not more reduced than in the Torrejon specimens, the proportions of the molars and size of the paraconid constitute an approach towards *Pachyæna.*

The milk dentition has not hitherto been known in this genus. The first premolar is one-rooted, and belongs apparently to the permanent series. The appearance of the first permanent premolar with or shortly after the succeeding milk premolars has also been observed by Wortman in *Hyænodon.* Dp_2 is small, compressed, two-rooted, with indistinct heel; dp_3 and dp_4 are narrow elongate compressed teeth with large anterior cusps (paraconids) and long trenchant heels, both paraconid and heel being relatively much larger than in the true molars, while the protoconid is small. They differ widely from the corresponding teeth in *Pachyæna gigantea* (see p. 97) both in proportions and the development of paraconid and heel; the milk dentition of the smaller species of *Pachyæna* is not known.

Dissacus prænuntius sp. nov.

Type, No. 16069, upper and lower teeth and fragments from Clark Fork Beds, Wyoming.

Distinctive characters: Smaller than *D. saurognathus;* larger than *D. navajovius;* paraconids of molars much smaller than in either species; metacone of m^3 vestigial.

This species is represented by but a single individual. The reduction of the anterior basal cusps on p_4 and on the molars preserved would seem to be a primitive character, preserved on m_3 in *D. saurognathus* and *navajovius,* but not on p_4–m_2. In the present species the paraconid is much more reduced on p_4, and is quite small on two incomplete molars which are, probably but not certainly, m_2 right and left. The first upper molar is decidedly smaller than the m^1 of *D. saurognathus,*[1] about equally larger than the corresponding tooth in *D. navajovius,* and closely resembles the m^1 of *Pachyæna.* The distal end of the humerus, the patella, tuber calcis and two phalanges indicate a species scarcely exceeding *D. navajovius* in size of limbs and feet, although the teeth are so much larger.

Pachyæna *Cope* 1874.[2]

Type, P. ossifraga from Wasatch of New Mexico.

Generic characters: Molars $\frac{3}{3}$; metaconids vestigial; paraconids large on p_4–m_3; pollex much reduced, probably vestigial.

Although originally described from a New Mexican specimen this genus is practically limited to the Gray Bull horizon of the Big Horn Wasatch. No additional specimens have been found in New Mexico nor in the later

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[1] M^2 of Osborn and Earle's figure.

[2] Rep. Vert. Foss. New Mex., p. 13.

horizons of the Wyoming Wasatch. It has not been found in the Clark Fork beds, and a single tooth is the only representative from the Sand Coulée beds. Dr. Loomis, however, reports finding it in the upper levels of the Big Horn Wasatch.

From the Gray Bull beds a number of skulls, jaws and skeletons all in a

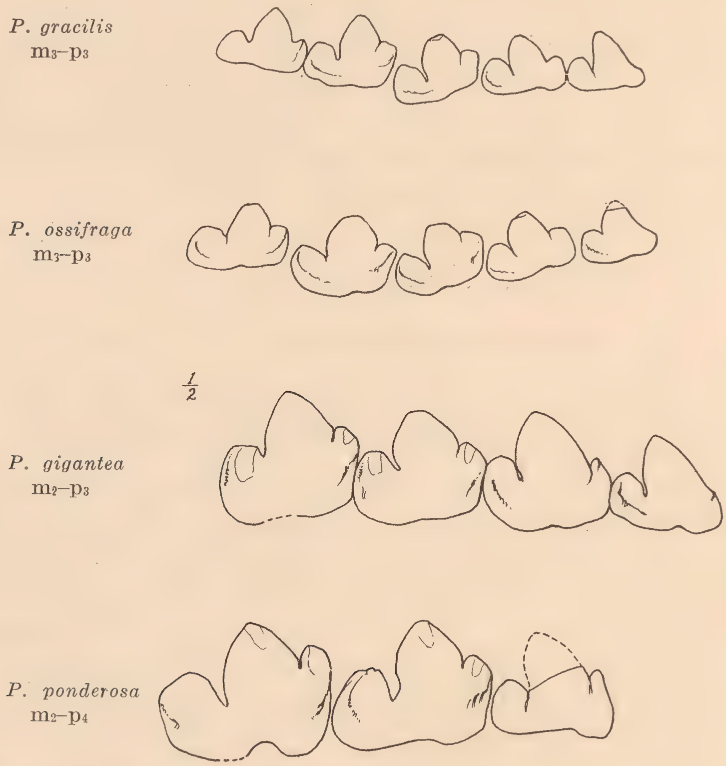

Fig. 78. *Pachyæna*, lower teeth of four species, outer views, half natural size. All from Gray Bull beds, Big Horn Basin, Wyoming.

more or less fragmentary condition have been secured by the various expeditions, and the osteology of the type species is fairly well known from the material now at hand. Three well distinguished species are represented, which agree approximately both in size and proportions with the three generic types of the Middle Eocene — *Harpagolestes, Synoplotherium* and *Mesonyx*. It seems probable that these three species of *Pachyæna* are ancestral to the three Bridger genera, but in the absence of intermediate links it cannot be regarded as proven.

The tetradactyl manus and pes sharply distinguish this genus from *Dissacus saurognathus*. In 1909 I stated with regard to *P. ossifraga* that: "The number of digits is not certainly known, but the structure of limb bones and foot bones as well as of the teeth is so much more like that of *Mesonyx* than of *Dissacus*, that there is little doubt that the feet were tetradactyl and digitigrade. Wortman, following Cope's erroneous determination of the humerus belonging to this species, regards it as pentadactyl."[1] This inference is now proven correct by the fore and hind feet of *P. ossifraga* herein described. The character is probably generic, although it remains inferential for the large *P. gigantea*. *Dissacus navajovius* on the other hand may have been tetradactyl. The limb and foot bones are incompletely known but indicate proportions much more slender and feet more compressed than in the large species.

Pachyæna gracilis sp. nov.

Type, No. 15729 lower jaws; paratype No. 15729, teeth and part of skeleton: both from the Gray Bull beds of the Big Horn Basin, Wyoming.

Distinctive characters: Total length of jaw = 244 mm.; canines and condyle much smaller, cheek teeth somewhat smaller and less robust than in *P. ossifraga*. Skeleton one-fourth smaller throughout, limbs somewhat more slender.

The most obvious difference from *P. ossifraga* lies in the much smaller jaw, scarcely two-thirds the length of Cope's species, with relatively thin and shallow ramus, short symphysis, small and slender canines, and small condyles. The cheek teeth are little less in length, but they are more compressed, with less robust cusps. The paratype shows the limbs and feet to be smaller than in *P. ossifraga*, and somewhat more slender; the feet do not, however, attain the slender proportions of *Mesonyx* but are more like *Synoplotherium*. The astragalus is like that of *P. ossifraga*, slightly wider and shorter necked. Metacarpal II and metatarsal II are like those of *P. ossifraga*, and indicate that both pollex and hallux were reduced to small vestigial nodules.

Measurements of P. gracilis.

	No. 15728
Lower jaw, incisive alveolus to condyles	244
" " depth at p_2	32
" " " " m_3	36
" " length of dentition, i_1–m_3	155
" " " " p_1–m_3	132
" " " " m_{1-3}	60
P_3 diameters a.-p. × tr.	16.8 × 7.5
P_4 " "	19.3 × 8.4
M_1 " "	19.8 × 8.8
M_2 " "	21.3 × 9.3
M_3 " "	20.5 × ?
	No. 15729
Upper canines, length incl. root	82.5
" " diameters, a.-p. × tr.	17.1 × 11.7

[1] Mem. Am. Mus. Nat. Hist., Vol. VI, p. 491.

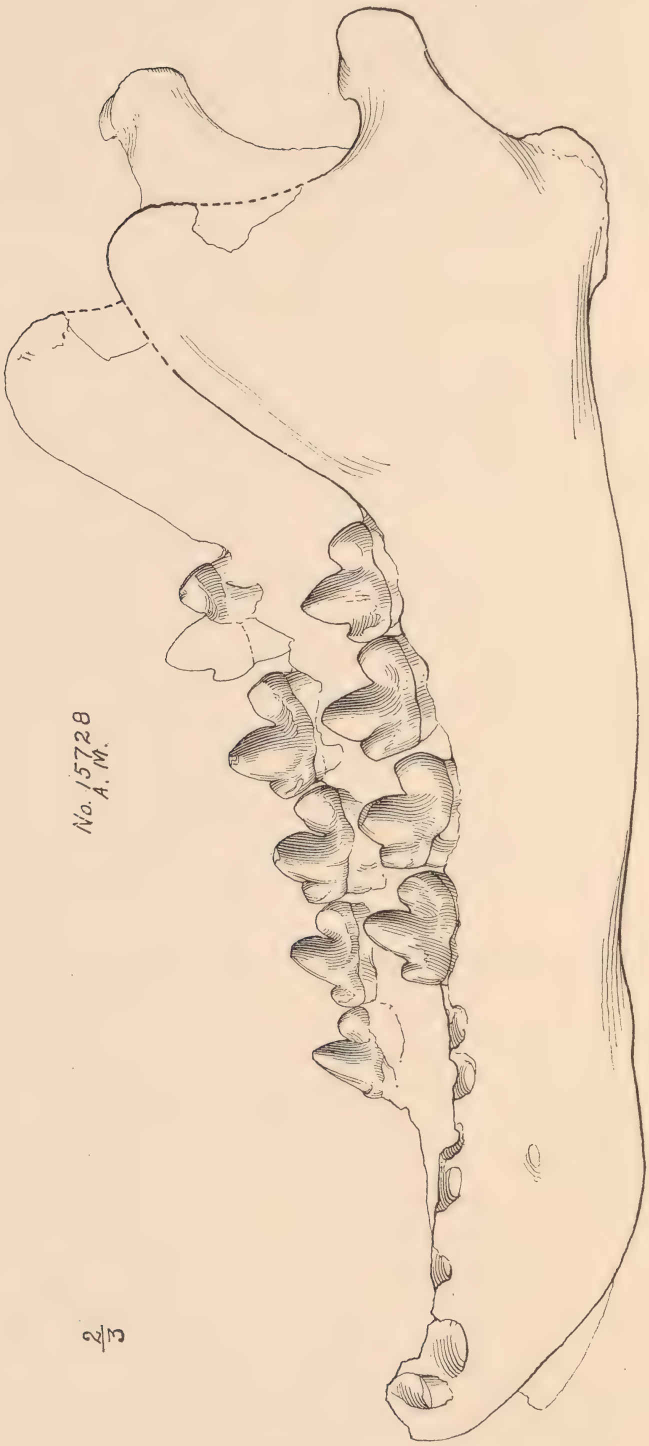

Fig. 79. *Pachyæna gracilis*, type specimen, lower jaw, two-thirds natural size. Gray Bull beds, Big Horn Basin.

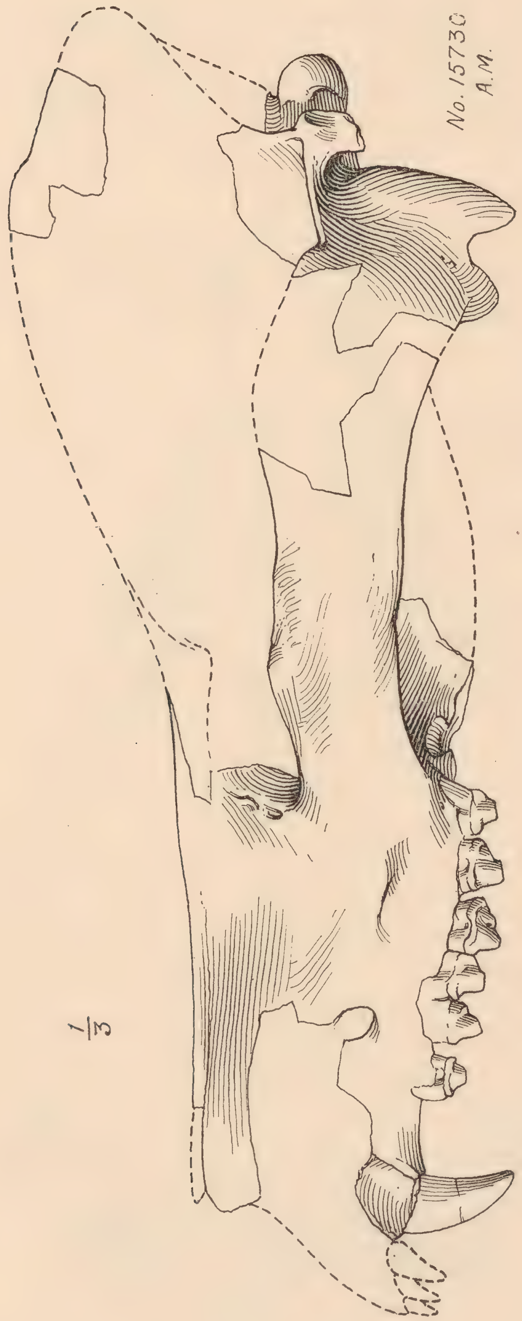

Fig. 80. *Pachyæna ossifraga*, skull, one-third natural size, No. 15730, lower Gray Bull beds, Big Horn Basin.

Pachyæna ossifraga *Cope* 1874.

Syn., *P. intermedia* Wortman 1899.

Pachyæna ossifraga Cope 1874, Rep. Vert. Foss. New Mex., p. 15; 1877, Ext., Vert. New Mex., p. 94, pl. xxxix, fig. 10; (*Mesonyx*) 1882, Pal. Bull. 34, Proc. Am. Phil. Soc., XX, p. 165; 1885, Tertiary Vertebrata, p. 362, pl. xxviiia, xxviiib, xxviiic, xxviiid.

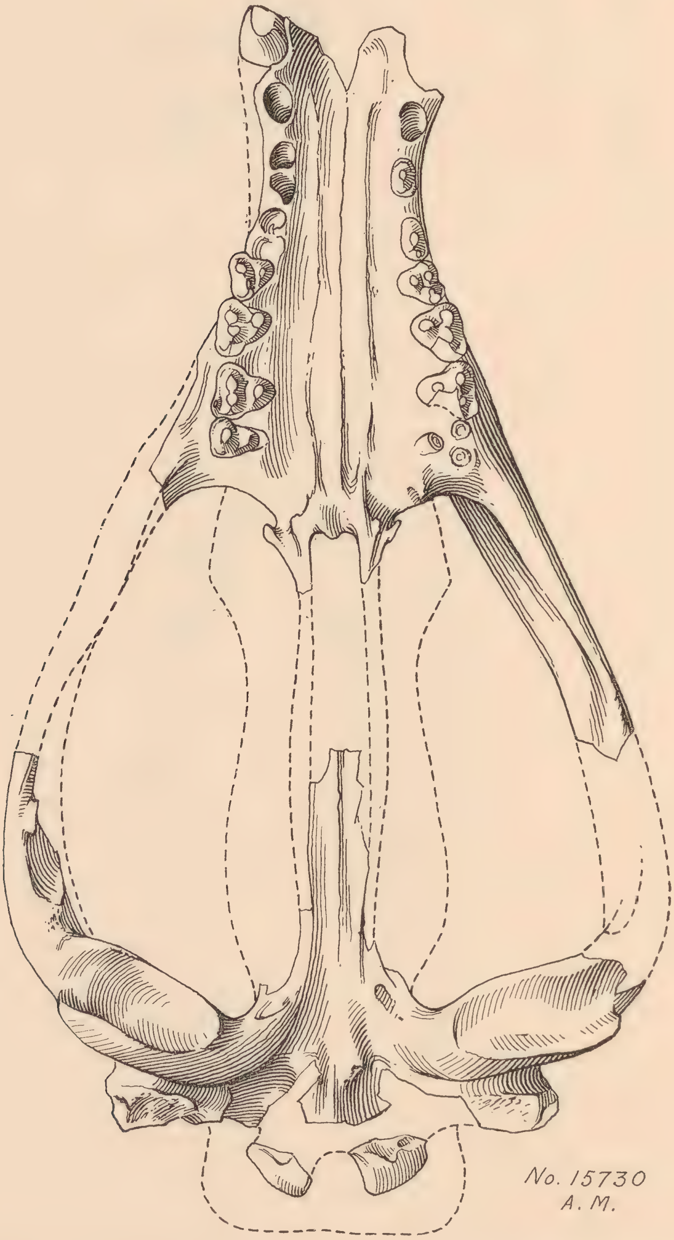

Fig. 81. *Pachyæna ossifraga*, palatal view of skull, one-third natural size. No. 15730, Gray Bull beds, Big Horn Basin.

Pachyœna ossifraga OSBORN (& WORTMAN) 1892, Bull. Am. Mus. Nat. Hist., Vol. IV, p. 112, fig. 11B; MATTHEW 1909, Mem. A. M. N. H., vol. IX, p. 489, 491, text fig. 91.

Pachyœna intermedia WORTMAN 1899, *ibid.*, Vol. XII, p. 147; MATTHEW 1909, *l. c.* (type only).

Type, U. S. Nat. Mus. No. 1096, an upper molar (m^1, 1.) from the New Mexican Wasatch. Metatype, No. 4262 an incomplete skull, jaws and parts of skeleton from the Big Horn Wasatch.

Type of *P. intermedia*, No. 2854 an upper jaw fragment with m^{2-3} from the Big Horn Wasatch.

Distinctive characters: Size medium, lower jaw 360 mm. in total length. Skull and jaws elongate, canines massive, condyles heavy. Limbs long and moderately slender, feet digitigrade tetradactyl. Metacones of upper molars moderately reduced, m^3 smaller than m^1 but variable in size.

A skull, No. 15730, and a skeleton, No. 16154, from the Gray Bull beds are referred to this species. Both are fragmentary and incomplete but the bone well preserved and uncrushed, and they add considerable to what has hitherto been known of the morphology of *Pachyœna.* A number of upper and lower jaws and jaw fragments are also referable.

Pachyœna intermedia of Wortman I am unable to separate specifically from *P. ossifraga,* although it is somewhat smaller than the skull and skeleton described by Cope (A. M. No. 4262) and the last molar slightly more reduced. It agrees more nearly with the skull and skeleton Nos. 15730, 16154, which in turn agree closely with the type of *P. ossifraga.* No. 4262 is a more robust individual, and the series of upper and lower jaws referred to the species show all kinds of intermediate conditions between these extremes. The hind limb referred to *intermedia* by Matthew in 1909 is undoubtedly of a distinct species from *ossifraga;* but it belongs not to *intermedia,* but to the smaller species *P. gracilis* described above.

The skull, No. 15730, as restored, is of very peculiar proportions. The mesocranial region is greatly elongate, the distance between m_3 and the postglenoid process exceeding the distance from canine to m_3; the glenoid articulations are very large, project far downward, and are, for a carnivore, set far back. The anterior border of the orbit is above the posterior end of m^3. The posterior nares open a little behind m_3, are very narrow and constricted, the pterygoid plates set near together. The proportions of the skull resemble those of *Harpagolestes* rather than *Mesonyx.* In the Cope skull (No. 4262) the posterior part has been telescoped and crowded together by crushing so that these proportions are not brought out. The skull of *H. macrocephalus* as figured by Wortman appears to be of about the same proportions except that the face is shorter and broader.

The feet in No. 16154 are nearly as progressive as those of *Synoplo-*

therium and *Mesonyx*. The trapezium and entocuneiform are reduced to about the same extent, and as in those genera have small facets for the first digit, which in the hind foot is clearly a small nodule indicated by a pit for its reception on mt. II. In the fore foot the pollex was probably also a vestigial nodule, as the facet for its articulation on the trapezium is quite small. The second metacarpal has much heavier shaft than the third or fourth, while the fifth is decidedly shorter than the fourth with about the

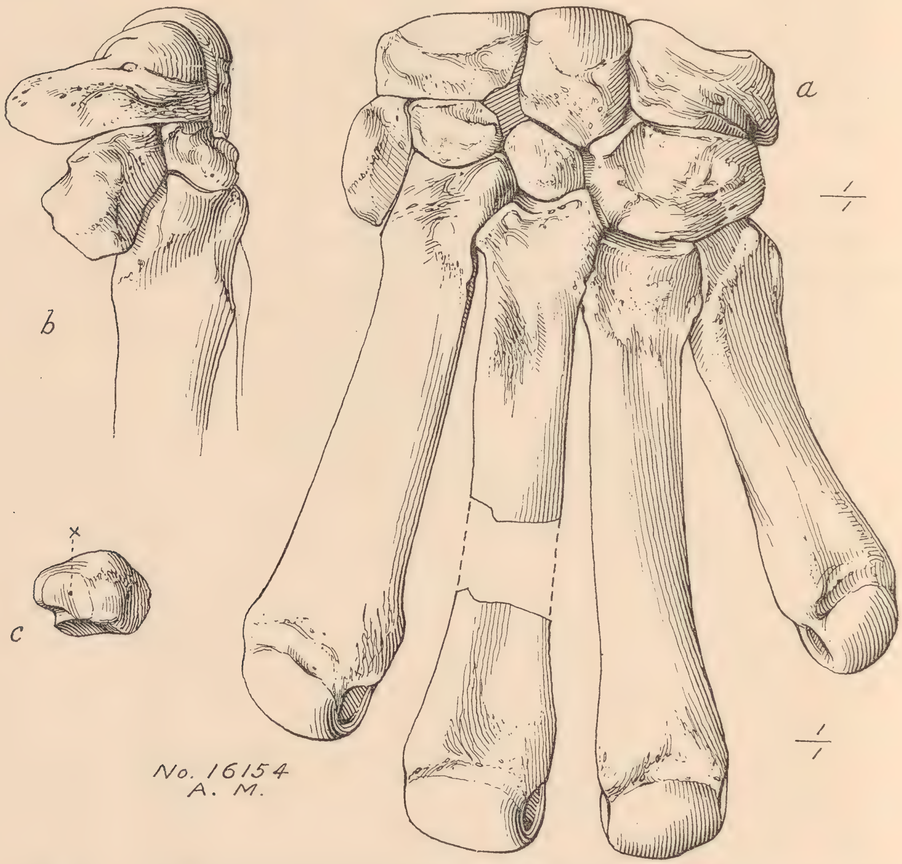

Fig. 82. *Pachyœna ossifraga*, fore-foot bones, natural size, *a*, proximal view of manus, *b*, inner view, *c*, distal view of trapezium showing the small facet for vestigial pollex. From skeleton No. 16154, Gray Bull beds of Big Horn Basin.

same weight of shaft. In the hind foot the fifth digit is much smaller than the others, but its length is not preserved, the second has a somewhat heavier shaft than the third and fourth. The distal ends of the metapodials and the phalanges show the same features as *Mesonyx*. The most obvious primitive character is the relative shortness and breadth of the astragalus and flatness of its trochlea.

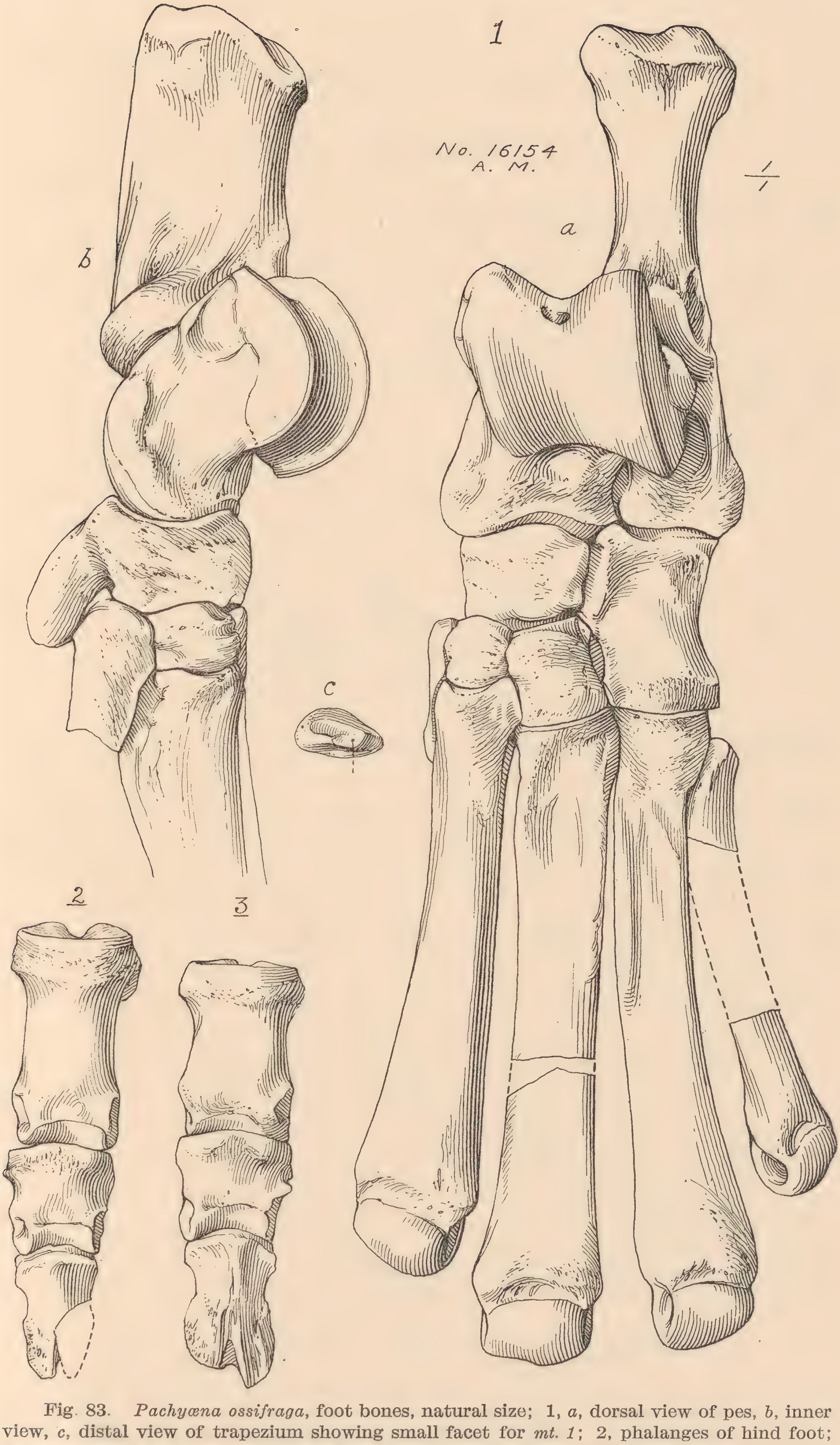

Fig. 83. *Pachyæna ossifraga*, foot bones, natural size; 1, *a*, dorsal view of pes, *b*, inner view, *c*, distal view of trapezium showing small facet for *mt. 1*; 2, phalanges of hind foot; 3, phalanges of fore foot. Skeleton No. 16154, Gray Bull beds, Big Horn Basin.

Measurements.

	No. 15730
Skull (as restored) length, canine to condyles	410
" " " width across arches	230
" depth at end including m^2	103.5
Palate, width " " " "	91.1
" distance of posterior nares behind m^3	24.3
" width of posterior nareal opening	17.2
Glenoid articulation, diams. (a. p. × tr.)	31. × 52.5
Zygomatic arch, depth at middle	44
Upper teeth, c–m^3	158
" premolars, p^{1-4}	76
" molars m^{1-3}	53
' canine, diameters (a.-p. × tr.)	22. × 17.
" p^2 " "	12.5 × 8.5
" p^3 " "	14.5 × 9.0
" p^4 " "	15.8 × 14.5
" m^1 " "	19.5 × 16.9
" m^2 " "	18.7 × 19.4
" m^3 " "	13.8 × 15.1
	No. 16154
Scapula, diameters of glenoid cavity	35. × 23.5
Humerus, diameters of proximal end	58.5 × 45.
" " distal end	32. × 34.5
Radius, circumference of shaft	47.0
" diameters of proximal end	17.8 × 28.8
" " distal	23. × 34.5
Ulna, length of olecranon	56.3
" diameters of olecranon	31. × 10
Fore foot, total length (approx.)	150
" " width of carpus	48.8
" " length of mc. II	70.2
" " " " " IV	72.7
" " " " " V	56.9
" " diameters of 1st phalanx, digit II, length × width	25.8 × 16.8
" " " " 2nd " " " " "	15.9 × 15.4
" " " " ungual " " " " "	18.7 × 12.7
Femur, diameter of head (caput)	30.7
" diameters of distal end (crushed)	42 × 54
" total length	258.0
Tibia, diameters of head	56.4 × 50.4
Fibula, diameters of distal end	21.6 × 15.4
Tibia, diameters of distal end	24.5 × 34
Astragalus, length	38.5
" width of body	32.3
" " " trochlea groove	19.3
Calcaneum, length	66.9
" diameters of tuber calcis	21.7 × 10.5

Cuboid, length	29.
" width of proximal end	20.7
Navicular, width	13.4
" height	14.7
" depth (including hook)	28.2
Metatarsal II, length	80.
Hind foot, total length (approx.)	232.

Pachyæna gigantea *Osborn* 1892.[1]

Type, No. 72, upper teeth, p^{2-4} m^{2-3}r; p^3–m^3l. from the Wasatch of the Big Horn Basin, Wyoming.

Distinctive characters: Length of jaw about 450 mm., very robust and massive, teeth much larger and more massive than in *P. ossifraga;* upper molars wider transversely, metacones more connate, $m\frac{3}{3}$ unreduced.

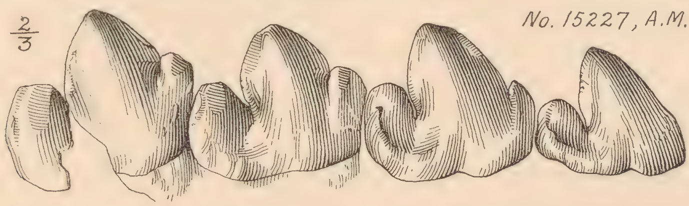

Fig. 84. *Pachyæna gigantea*, lower teeth, p_3–m_2, two-thirds natural size. No. 15227, Gray Bull beds, Big Horn basin.

To this species were referred in 1901 a fragmentary skeleton, No. 2959, and a weathered skull and jaws No. 2823. Two additional specimens are now referred, nos. 15227, upper and lower teeth, 15226 young lower jaws with milk dentition.

The fourth upper premolar of the type belongs, I suspect, to the milk dentition; it is much more worn than the teeth preceding or following it, and the tooth which I identify as p^4 in other individuals is quite different in proportions and construction. The lower milk teeth are well shown in No. 15227. P_1 belongs to the permanent series but appears only a little later than the succeeding milk premolars. Dp_2 is a very small tooth, two-rooted, compressed, with distinct heel. Dp_{3-4} have nearly the same cusp construction as their permanent successors, but are much smaller and more compressed and the paraconid is rudimentary on dp_3, strong on dp_4. They are readily distinguishable from permanent teeth of a smaller species by the rectangular outline. They are not nearly so elongate as the milk premolars of *Dissacus,* the protocones much larger in proportion to the anterior and posterior cusps.

The sagittal crest in this specimen is very high, although the animal was so young.

[1] Osborn (& Wortman) 1892, Bull. A. M. N. H., vol. IV, p. 113, figs. ii, 12.

Measurements.

	Type, No. 72	No. 2959	No. 15227	No. 15226
P^1, diameters a.–p. × tr.				
P^2 "	18.4 × 15.4			
P^3 "	20.3 × 17.2			
P^4 "		22.8 × 23.5	24.4 × 24.6	
M^1 "	26.0 × 25.8		25.4 × 27.1	
M^2 "	26.4 × 30.7	26.8 × 26.6	? × 28.5	
M^3 "	25.9 × 25.4	22.5 × 27.8		
Dp^4 "	23.0 × 20.6			
C_1 "		30.8 × 21.8		
P_1 "				10.7 × ?
P_3 "		25.0 × 15.1	25.6 × 14.8	
P_4 "			28.9 × 16.4	
M_1 "		28.7 × 15.3	30.0 × 17.5	
M_2 "		32.2 × 15.3	31.4 × 18.1	
M_3 "		30.0 × 13.9		
Dp_2 "				10.2 × 4.7
Dp_3 "				18.3 × 8.9
Dp_4 "				23.9 × 11.0
Astragalus, diameters		57.0 × 56.4		
" width of trochlea		32.8		

Pachyæna gigantea ponderosa subsp. nov.

Type, No. 15228, upper jaw, lower teeth, astragalus and lunare, from Gray Bull beds of Big Horn Basin.

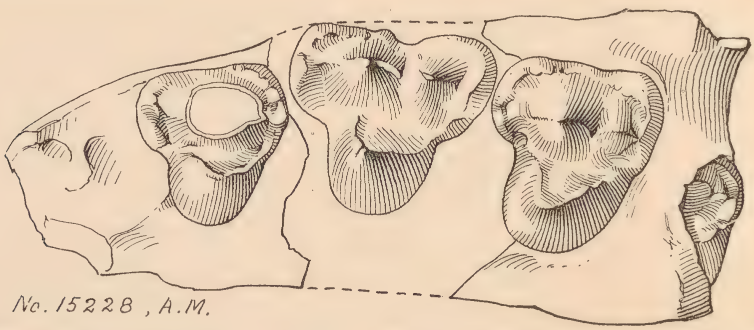

Fig. 85. *Pachyæna gigantea ponderosa.* Upper teeth of type specimen, two-thirds natural size. Gray Bull beds, Big Horn Basin.

Distinctive characters: M^{1-3} = 85 mm. M^{1-2} larger, m^3 smaller than in *gigantea*. Astragalus one tenth broader.

Although closely allied to *P. gigantea*, the larger size of the teeth and greater reduction of m^3 constitute a marked approach to *Harpagolestes*, and it seems advisable to name this form on this account and because it is the largest Lower Eocene creodont.

An upper and lower molar No. 15259 from the lower Gray Bull valley are referred to this species.

Measurements.

	Type No. 15228	No. 15259
P^3 diameters, a.–p. × tr.	22.5 × 17.3	
P^4 " "	26.3 × 26.8	
M^1 " "	34.8 × 34.7	
M^2 " "	29.0 × 33.3	31.7 × 34.7
M^3 transverse diameter	22.6	
P_4 diameters, a.–p × tr.	26.7 × 17.2	
M_1 " "	33.9 × 19.3	
M_2 " "	42.7[1] × ?	35. × 18.6
Astragalus, diameters (width × length)	60.0 × 61.6	
" width of trochlea	32.9	
Lunare, diameters (width × height)	25.3 × 26.0	
" depth (dorso-plantar)	37.0	
Proximal phalanx, length	39.0	
" width of shaft	21.0	

This genus is represented in the Soissonais by a species which Dr. Boule[2] finds indistinguishable from *P. gigantea* on the materials available for

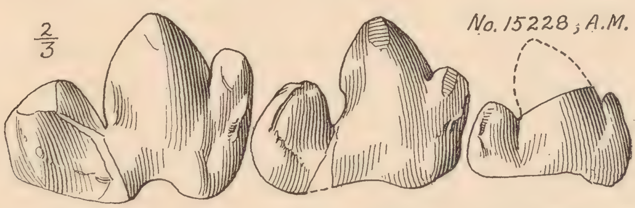

Fig. 86. *Pachyœna gigantea ponderosa*, lower teeth of type specimen, p_4–m_2, two-thirds natural size. Gray Bull beds, Big Horn Basin.

comparison. Dr. Trouessart gave the specimen the name of *P. boulei* two years later,[3] but without specifying any distinctions, or reasons for separating it from *P. gigantea*. Boule's figures show it to be very closely allied to our species, and so far as comparisons can be made, indistinguishable. I presume that Dr. Trouessart's separation of *P. boulei* is based upon the improbability, real or supposed, of the same species occurring in Europe and North America; an argument which to my mind may properly be used to

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[1] Increased by crushing of the tooth.

[2] 1903. *Le Pachyœna de Vaugirard.* Mem. Soc. Geol. Tr., Vol. X, fasc. 4, Mém. no. 28, pp. 1–16, pl. i, ii (xiv, xv).

[3] 1905, Catalogus Mammalium, Quinq. Suppl., p. 163. This is the only reference that I have been able to find.

retain a species already made, although not to make a new one. On this ground therefore I retain Trouessart's species although a careful comparison of Boule's figures and description fails to reveal any valid specific characters.

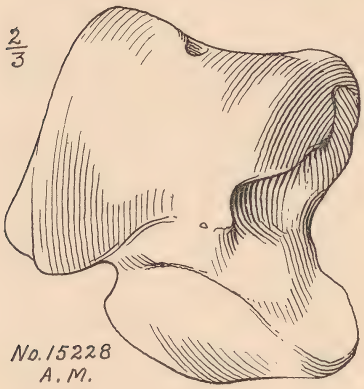

Fig. 87. *Pachyæna gigantea ponderosa*, astragalus, superior view, two-thirds natural size. From the type specimen.

The Fayûm "*Pachyæna.*" Schlosser has referred to "*Pachyæna* oder *Palæonictis ?*" a scapholunar bone from the Fayûm Oligocene; a reference which I criticized in reviewing his preliminary paper, on the ground that:

(1) In *Pachyæna* the scaphoid and lunar were certainly separate, nor is there any evidence nor probability that they were united in *Palæonictis*.

(2) Both genera are of Lower Eocene age, and belong to families of Creodonta of which no trace has been found in the Fayûm fauna or the Oligocene Epoch, and in which the scaphoid and lunar were never united so far as we know.

(3) On the other hand, we know that the Hyænodonts were represented by several genera in the Fayûm and are the only Carnivora positively known in this fauna;

(4) The Hyænodonts are the only family of Creodonts known to survive into the Oligocene, and in *Hyænodon* at least the scaphoid and lunar were sometimes united.[1]

From the above facts of record I concluded that "the probabilities, therefore, are greatly in favor of this scapholunar representing a large Hyænodont."

In Dr. Schlosser's final memoir he replies to the above criticism at some length, and figures the bone in question. He has somewhat shifted his ground, attempting to prove that it is a descendant of *Pachyæna* or *Palæonictis*, the argument being that it does not agree in form with the *Hyænodon* scapholunar illustrated by Wortman,[2] and does not agree in size with the radius that Schlosser attributes to *Pterodon*, and that the other known genera are too small.

Apparently Dr. Schlosser regards this as a complete answer to my

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[1] That is, according to recorded statements of Cope and Wortman. I do not desire to be understood as indorsing this assertion.

[2] 1902, Amer. Jour. Sci., XIII, 136, fig. 91. Wortman's figure is very different in form and proportions from the conjoined scaphoid, lunar and centrale in our *Hyænodon* skeletons, but is not unlike the scapholunar of *Daphænus*, to which genus I suspect that the bone really belongs although found with fragments of jaws and bones of *Hyænodon crucians*.

criticism, and considers that he has "stilled my doubts" as to the propriety of his reference of the specimen under consideration. But he gives no morphologic reasons at all for referring the bone to the Oxyænidæ or Mesonychidæ rather than to the Hyænodontidæ. In default of such evidence the argument stands untouched. It is more probable that the bone represents an unknown or indeterminate genus of a family that: (1) does occur in the Oligocene; (2) does occur in the Fayûm fauna, and is the only Carnivore family known from that fauna; and (3) is recorded as occasionally uniting the scapholunar, than that it belongs to an undescribed genus of families that: (1) do not occur in the Oligocene but become extinct in the Eocene, so far as known; (2) are quite unknown to the Fayûm fauna; and (3) never unite the scaphoid lunar or centrale in any of the genera.

It is quite evident from the figure that this scapholunar is not *Hyænodon*. I am well acquainted with the osteology of this genus, and while I have never seen among many skeletons studied, any instance of a united scapholunar, yet the form of the individual bones of the carpus would result in case of union of scaphoid lunar and centrale in a bone with distal facets of widely different type from those of the Fayûm specimen, which differs from the corresponding bones of *Pachyæna* in substantially all the same points that separate it from *Hyænodon*.

It is not so clear that the bone is not *Pterodon* or *Apterodon*. Its failure to agree in size with the limb bones assigned by Schlosser and Andrews to various species of these genera would be conclusive as to those particular species if there were any certainty that these limb bones were correctly referred in all cases. But there is practically no association of jaw and limb parts among these Fayûm carnivora and the references have been made upon agreement in general characters, proportionate numbers, and relative size. Such arbitrary references are more often wrong than right; as a result of the study of associated specimens of single individuals we have learned in this museum that they are wholly untrustworthy. But even if all these bones were correctly referred, disagreement with them would not prevent the scapholunar from belonging to some other species or genus of Hyænodonts. Its relative size it must be remembered is no criterion. I showed in 1909 among the Miacidæ a variation in size of teeth relative to limbs of 300% between different genera.

It is and was quite obvious to me that Dr. Schlosser's real reasons for assigning this bone to "*Palæonictis* or *Pachyæna*," are the fact that these two genera occur in the early Eocene of Europe, and his theory that a large part of the Fayûm fauna is derived by immigration from the north — a theory in which I very readily concur. If these genera of the Lower Eocene of Europe left descendants in the Lower Oligocene of Africa it would doubtless be an additional argument for this theory. But I do not think the theory should be bolstered by unsound evidence, and as such I am compelled to regard this reference.

Briefly, the bone is not *Hyænodon* nor closely related thereto, but it might represent some other genus of Hyænodonts, known or unknown, or, less probably, some genus of Miacidæ or of Fissipedia or some other Creodont or Pinniped family. Since there are no clearly defined characters at present known distinctive of the carpal bones in the several families, as such, of Creodonts and early Carnivora, it is not possible to refer this bone with certainty to any one family. The probabilities stand as stated above.

One thing however may be stated with certainty. The bone is not *Pachyæna, Dissacus, Mesonyx* or *Synoplotherium,* nor is there any valid evidence for referring it to *Palæonictis.*

Hapalodectes *Matthew* 1909.[1]

Type, H. leptognathus from the Wasatch, Wyoming.

Generic characters: Dentition $\overline{?\ 0.1.4.3}$; jaw slender, teeth highly compressed, metaconids small, paraconids well developed on m_1–m_3, talonids high, sharp, trenchant.

The species referred to this genus are represented by lower jaws only, the upper dentition, skull and skeleton being unknown. They are of much smaller size than other Mesonychidæ, and the knife-like teeth are unworn in any of the specimens. They do not show any indications of shearing action.

H. compressus Matthew is distinguished by the more slender jaw and somewhat greater compression of the teeth, characters more marked in referred specimens from the Lost Cabin horizon than in the type which is from the Lysite.

Seven lower jaws altogether are referred to the genus, two probably Gray Bull, one from Lysite of the Big Horn, three from Lysite of the Wind River Basin, and one from the Lost Cabin horizon of the Wind River. They show a progressive slenderness of jaw and greater compression of the teeth.

Hapalodectes leptognathus (*Osborn* 1892).

Dissacus leptognathus Osborn (& Wortman) 1892, Bull. Am. Mus. Nat. Hist., Vol. IV, p. 112, fig. 10; (*Hapalodectes*) Matthew 1909, Mem. A. M. N. H., vol. IX, p.

[1] U. S. G. S. Bull. 361, p. 93.

Type, No. 78, part of lower jaw with p_4–m_2.
Specific characters: P_4–m_3 = 23.8; depth of jaw at m_3 = 13.

The type is from the Wasatch of the Gray Bull River, Big Horn Basin, exact horizon unrecorded but almost certainly from the Gray Bull level. Another jaw fragment from the Big Horn Basin, level unrecorded, was referred to the species by Osborn, but shows no teeth.

Hapalodectes compressus *Matthew* 1909.

Hapalodectes compressus Matthew 1909, Mem. A. M. N. H., Vol. IX, p. 499, pl. xlv, fig. 5, text fig. 101.
Type, No. 12781, lower jaw from Lysite horizon of Cottonwood Creek, Wind River Basin. Paratype No. 12782 from same level and locality.
Specific characters: P_4–m_3 = 22; depth of jaw at m_3 = 11.4.

No. 14748, a lower jaw from the Lost Cabin beds of Alkali Creek is more clearly differentiated than the type from *H. leptognathus,* the lower jaw having a depth of only 9 mm. and the molars still more compressed, the canine very long and slender. Another jaw from the Lysite of Buffalo Basin in the Big Horn Valley agrees more nearly with the type.

59.57.52

Article II.— DESCRIPTIONS AND RECORDS OF COCCIDÆ.

By T. D. A. Cockerell and Elizabeth Robinson.

Trionymus violascens *Cockerell.*

Mr. E. Bethel sends abundant material, labelled, "on *Agropyron occidentale* (*A. smithii*), vacant lots in Denver, Colo., Oct. 5, 1914." He notes that it "is the most common and destructive insect to grasses that we have, as it is widely distributed, and very abundant in many places." At Walsenburg, where Mr. Bethel first found this coccid, the grass was only half its normal size; he adds that cattle will not eat it when thus affected.

Eriococcus costaricensis n. sp.

♀. Length about 1.75 mm., in a perfectly white sac; body turning bright red when boiled in KOH. Tarsus distinctly longer than tibia; claw with denticle on inner side near apex (this denticle is also present in *E. adenostomæ*, *E. cockerelli* and *E. palmeri*).

The following measurements are all in microns: antennæ 7-jointed, joints (1.) 30, (2.) 33, (3.) 50, (4.) 39, (5.) 20, (6.) 20, (7.) 35. Dermal spines about 25 long. Caudal lobes large, about 63 long, armed as in *E. cockerelli*, their bristles about 175 long. Bristles of anal ring about 88 long. Middle femur with trochanter about 160 long. Anterior tibia, 88, tarsus (the tarsus in each case measured without claw) 113; middle tibia, 100, tarsus 118; hind tibia, 105, tarsus 125.

Hab.— On twigs of *Vaccinium*, with much black fungus; Mt. Irazu, Costa Rica, 11,300 ft., March 15, 1913 (*E. Bethel*).

Differs from *E. cockerelli* Essig by the longer tarsus, and from *E. adenostomæ* Ehrhorn by the third antennal joint conspicuously longer than the last, as well as the larger size. All these insects are very closely related, and could be regarded as subspecies of a single widely distributed species, but it is probable that they would appear more distinct in life, especially if the earlier stages and males were known. The *Eriococcus* type is extraordinarily conservative, and shows surprisingly little modification in the most remote localities, although the various species or races must have been isolated for ages.

E. costaricensis comes from the highest altitude yet known for a Coccid.

Eriococcus tinsleyi *Cockerell.*

Walsenburg, Colorado, on *Malvastrum coccineum*, Aug. 16, 1911 (*E. Bethel*).

Pseudococcus filamentosus *Cockerell.*

Tanghulan, Mindanao, on *Coffea*, very destructive (*Baker*).

Gossyparia spuria (*Modeer*).

Denver, Colorado, immature, wintering on bark of elm (*E. Bethel*).

Fonscolombia braggi n. sp. (Figs. 11–15.)

♀. Elongate (when mounted on slide), 165 microns long and 75 broad, the sides nearly parallel. Bright raspberry red in life; colorless after boiling. In the following account the measurements are all in microns:

Antennæ 7-jointed, joints 3 to 6 broader apically than basally, so that the lateral profile is stair-like; joints 5 and 6 each with a curved spine at side, 7 with a spine and many bristles; length of joints, (1.) 25, (2.) 18, (3.) 32, (4.) 20, (5.) 16, (6.) 16, (7.) 26. Distance between antennæ 70, width of base of antenna 45. Derm with scattered round glands, and very minute bristles. Mouth parts large, about 125 across; labium short, about 63 long and broad at base, not distinctly jointed. Anal ring with six short spines. Caudal bristles about 140 long. Anterior femur with trochanter 112, middle ditto 120, hind ditto 125; middle tibia 55, hind tibia 75; hind tarsus (excluding claw) 87; tarsi curved. The claw has a very minute denticle on inner side near end.

Second stage.— Antennæ 6-jointed, 52 apart; joints measuring (1.) 20, (2.) 18, (3.) 20, (4.) 13, (5.) 14, (6.) 25. Legs stout; middle leg measuring, femur with trochanter, 88; tibia, 45; tarsus (without claw) 50. Tarsus with two stout bristles on inner side. Derm with regularly placed (in longitudinal and transverse rows) small nipple-like narrowly truncate glands.

Hab.— On roots of *Berberis repens*, Boulder, Colorado, May 31, 1911 (*Bragg*).

The genus was described from Europe, and is new to America. The species is aberrant by the seven-jointed antennæ and the character of the dermal glands, but it does not seem necessary to propose a new generic name for it. The females produce a quantity of loose white cotton-like secretion, but are not hidden by it. Our examples, though adult, had not begun to produce eggs.

Ripersia trichura *Cockerell.*

On April 4, 1914, we found several specimens of this elongate species under rocks, in nests of *Lasius americanus* and *Formica* sp. at Boulder, Colorado. It is new to Colorado.

Aspidiotus translucens (*Cockerell*).

This is usually called *A. transparens* Green, but that name was originally applied to *A. destructor* Signoret.

Los Baños, Philippine Is. (*C. F. Baker*); collected on *Carica papaya, Dioscorea alata, Aleurites moluccana, Mangifera indica* and *Codiæum.* (Baker 885, 1160, 2180, 2371, 2372.)

Hemichionaspis aspidistræ (*Signoret*).

Professor Baker writes that his 1751, recorded as from *Smilax,* was really on *Erythropalum scandens.* He also writes that *Protopulvinaria longivalvata bakeri* was on *Voacanga globosa* (Apocynaceæ), and *Pinnaspis buxi* was on *Homalomena* (not *Aglaonema*) *philippinensis.* Also, *Paralecanium luzonicum* was on *Plectronia* (not *Alectronia*) *viridis.*

Aspidiotus ehrhorni *Coleman.* (Fig. 10.)

Described from California, on *Abies* and *Libocedrus.* Mr. L. C. Bragg found it among lichens on the bark of *Pseudotsuga mucronata* at Boulder, Colorado. Our material seemed to differ a little from Coleman's description, but it agrees with cotype specimens. We give a new figure, showing variations.

Chrysomphalus pedroniformis n. sp. (Fig. 8.)

Female scale circular or oval, about 1.75 mm. diameter, slightly convex, dull pale reddish-brown with the margin whitish; exuviæ large, nearly central to sublateral, usually darker than the rest of the scale, with the first skin appearing as a shining, more or less golden boss.

Adult female bright yellow when boiled in KHO, almost circular, at period of gestation with pygidium partly contracted within the body; segmentation distinct; pygidium with three pairs of well developed lobes; median and second lobes with a single notch on each side, or second lobes may be without the inner notch; third lobe with a single notch on outer side; two fringed plates between the widely separated median lobes, and two fringed plates between the first and second, and second and third, these conspicuous and well developed; beyond the third lobe three plates with long acute terminations, and just beyond these a slight angular projection of the margin; a short spine laterad of each lobe; club shaped organs at bases of lobes very small; circumgenital glands with anterior lateral groups each of 5 to 8 orifices, posterior lateral of 3 to 5; dorsal pores in two rows on each side, 8 to 12 pores in each row; also a small central group of dorsal pores near the anal opening. Immature female somewhat smaller, with only the median lobes well developed.

Male scale elongate-oval, pale, with darker exuvia.

Hab.— On bark of small branches of *Vitis vinifera,* Los Baños, Philippine Is., March 16, 1914 (*C. F. Baker* 2374).

Very close to *Chrysomphalus pedronis* (Green) from Ceylon, but the median lobes are differently shaped, with the part beyond the notches much shorter, and the scale is quite differently colored. It also resembles *C. dictyospermi* (Morgan), but differs at once by the short club-shaped glands and the median lobes notched on inner side.

Fiorinia phantasma n. sp. (Figs. 6, 7.)

Female scale about 1.25 mm. long, of the usual elongate form, very pale greyish ochreous, very inconspicuous on the whitish surface of the under side of the leaves of *Neolitsea;* first skin elongate oval, extending beyond anterior end.

Adult female pale yellow, during gestation with the abdominal segments contracted; pygidium with median lobes widely divergent, not greatly produced, their inner margin with 4 to 6 teeth; no distinct additional lobes, but margin with triangular dentiform projections as shown in the figure; two pairs of large spines on each side, as figured; lateral margins anterior to pygidial area parallel; circumgenital glands with posterior lateral groups each 10 to 13 orifices, anterior lateral of 10, median group of 5; antennæ close together, without any stiff spine, between them is a serrate plate.

Second stage female elongate; pygidial structure not unlike that of *F. fioriniæ*, with well developed narrow second lobes.

Male scale white, parallel sided, broad, with pale yellowish first skin.

Hab.— On *Neolitsea*, on under side of leaves, Mt. Makiling, Philippine Is., Jan. 31, 1914 (*C. F. Baker* 2370).

Closely related to *F. saprosmæ* Green, but differing conspicuously in the shape of the abdomen and the number of circumgenital glands. Also allied, but not so closely, to *F. theæ* Green.

Pseudaonidia *Cockerell.*

The genus *Pseudaonidia* was revised by Mr. C. L. Marlatt in Proceedings Entomological Society of Washington, ix (1908), pp. 131–141, fifteen forms being recognized. Three of these belong to *Selenaspidus*, which appears to be a sufficiently distinct genus, and has been accepted as such by Lindinger, who has added to it several new species from Africa. True *Pseudaonidia* has also received some additions from various parts of the Old World. In Marlatt's revision, just cited, various North and South American localities are given for species of this genus, but in every case these represent introduced forms, brought from the Old World on plants, and here and there becoming established. The Monthly Bulletin of the Californian Commission of Horticulture, published at Sacramento, gives lists of the insects intercepted by the quarantine officers at San Francisco, and it is shown that every year many consignments of plants arrive from Japan, infested with *Pseudaonidia pæoniæ* and *P. duplex*. Many years ago Professor C. H. T. Townsend collected a remarkable new *Pseudaonidia* in the State of Vera

Cruz, Mexico, and one of us (Cockerell) had sent the description for publication, when he received the same insect from Mauritius, along with a paper in which it had been described by Mr. d'Emmerez de Charmoy. It is now certain that the species belongs to the Old World tropics, and had been introduced in Mexico.

We have now to describe a distinct new species from the Philippine Islands.

Pseudaonidia obsita n. sp. (Fig. 1.)

Female scale circular, slightly convex, about 2.5 mm. diameter, appearing brownish-black, but actually light brownish-pink (as in *P. trilobitiformis*), with a thick covering due to a fungous growth; exuviæ yellowish-fulvous, sublateral; ventral film thick, white. Occasionally the scales are white.

Adult female somewhat oval, but produced posteriorly; length about 1.75 mm.; dark brown, integument thick, segments distinctly marked; dorsal pores in rows, minute, not very numerous; circumgenital glands with anterior lateral groups of 27 to 29 orifices, and posterior lateral with 33; abdomen with a large reticulated area; pygidial margin with three pairs of well-formed lobes, and a fourth rudimentary; median pair dark, relatively short and broad, obscurely notched on each side; second and third pairs pale, narrow, elongate, with a notch on the outer side; fourth lobes indicated by a prominent subangular projection just beyond the last of the bidentate squames; squames in interlobular intervals strongly bidentate, with an occasional small tooth at side; a spine laterad of second and third lobes.

Male scale broad-oval, about 1.5 mm. long, dull brown-pink, with the pale orange first skin near one end.

Larva pink, with the caudal end yellowish.

Hab.— Los Baños, Philippine Is., abundant on the under sides of leaves of *Ficus caudatifolia*, collected by C. F. Baker (2376).

Related to *P. baikeæ* (*Aspidiotus baikeæ* Newstead, Bull. Entom. Research, iv, p. 308, Feb., 1914), from Uganda, but in that species the scale is white or yellowish-white, there are no circumgenital glands, and the lobes and squames are somewhat differently formed. In Marlatt's table it runs to the vicinity of *P. curculiginis* (Green), which has the fourth lobes highly developed, resembling the median ones in form, and lacks the tessellated pygidial patch. According to Green, *P. curculiginis* has the circumgenital glands in groups of about 12 each; Marlatt's account is different, but neither agree with our species. Compared with *P. trilobitiformis* (Green), the new species differs in the form of the lobes, and the squames are much narrower.

We figure the caudal ends of several species of *Pseudaonidia* (figs. 2–5), to show the strikingly different types. It might be supposed that *P. tesserata*, with its low broad lobes, could not be congeneric with *P. obsita*, but *P. clavigera* is more or less intermediate, as shown by the forked squames and triangular fourth lobe. A species with even lower and broader lobes than *P. tesserata* is *P. fossor* (*Aspidiotus fossor* Newstead, 1914), found on grape vine in Barbados, but doubtless of Old World origin.

Pinnaspis siphonodontis n. sp. (Fig. 9.)

Female scale about 1½ mm. long, mytiliform, rather narrow, pale red-brown, somewhat translucent, the shrunken female beneath showing as a dark spot occupying about half of the large second skin, which is about ¾ mm. long.

Female yellowish, elongated; abdominal segments distinct, produced laterally into large tubercles, the posterior two on each side each bearing a pair of spine-like squames; caudal region with the median lobes prominent, almost contiguous, rounded apically, and with a single deep notch on the outer side; next to these on each side is a spine-like squame, then a pointed glandular projection, then two rather small lobes shaped like the blade of an axe, then a spine-like plate, then a pointed projection, then the margin is finely serrate for some distance, after which comes a very large spine-like plate, then a projection of the margin, and beyond, at some distance, a single spine-like plate, and beyond this a pair of such plates, the formula for the spine-like plates being therefore 1, 1, 1, 1, 2. Circumgenital glands in five groups; median with 4 orifices, anterior laterals 10, posterior laterals 9 to 11.

Male scale a little over half a mm. long, parallel-sided, strongly tricarinate, but brown, with the same color and texture as the female scale.

Hab.— In groups on upper side of leaves of *Siphonodon celastrineus* Griff. (Celastraceæ), the scales nearly all oriented in the same direction, much in the manner of *Hemichionaspis theæ*. Los Baños, Philippine Is., Feb. 1, 1914 (*C. F. Baker* 2372).

Related to *Pinnaspis buxi* (Bouché), but readily distinguished by the double second lobe and the form of the median lobes.

Neolecanium cribrigerum n. sp. (Figs. 16–19.)

♀. Perfectly flat, broad-oval, about 4.25 mm. long and 3.55 broad; no glassy or waxy covering; rich red-brown. (The larvæ are much narrower.) Derm translucent brownish after boiling, in the posterior region with scattered large glandular structures, shaped like an ink bottle, each emitting a very short bristle. In the abdominal region are six large patches which are more strongly chitinized than the surrounding tissues, and are perforated with a number of small round gland-orifices; these patches are three on each side, arranged in a semicircle, in the middle of which are the anal plates.

Mouth very small. Antennæ rudimentary, without joints. A rather large circular orifice in the derm on each side laterocaudad of the antennæ.

No legs. Margin with a very few exceedingly minute simple bristles.

Anal plates triangular, rounded at end, caudolateral side a trifle shorter than cephalolateral. Anal ring appearing moniliform.

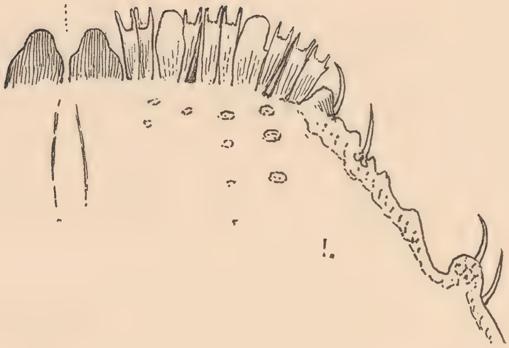
Hab.— On *Piper loheri*, occurring on the leaves; Los Baños, Philippine Is. (*Baker* 1754).

This is provisionally placed in the American genus *Neolecanium,* but it probably represents an independently evolved branch of the Lecaniine series, which when better known will appear to deserve generic rank.

Neolecanium crustuliforme Green, from Ceylon, is not a member of this genus; it is to be called *Platysaissetia crustuliformis.* The genus *Platysaissetia* was based on a species from Mexico.

Explanation of Figures.

1. *Pseudaonidia obsita* n. sp. Caudal end of adult female.
2. *Pseudaonidia baikeæ* (Newstead). After Newstead.
3. *Pseudaonidia tesserata* (de Charmoy). Coatzocoalcos, Mexico (*Townsend*).
4. *Pseudaonidia pæoniæ* (Cockerell). Japan. One of type lot.
5. *Pseudaonidia clavigera* Cockerell. Natal. From type.
6. *Fiorinia phantasma* n. sp. End of abdomen of adult female. A. Antennæ, adult female.
7. *Fiorinia phantasma* n. sp. End of abdomen of second stage female.
8. *Chrysomphalus pedroniformis* n. sp. End of abdomen of adult female.
9. *Pinnaspis siphonodontis* n. sp. Caudal end of adult female.
10. *Aspidiotus ehrhorni* Coleman. Caudal end of female. Boulder, Colorado (*Bragg*).
11. *Fonscolombia braggi* n. sp. Leg of female.
12. *Fonscolombia braggi* n. sp. Antenna of female.
13. *Fonscolombia braggi* n. sp. Antenna of female, second stage.
14. *Fonscolombia braggi* n. sp. Anal ring and adjacent parts of second stage female.
15. *Fonscolombia braggi* n. sp. Glands of second stage female.
16. *Neolecanium cribrigerum* n. sp. Antenna.
17. *Neolecanium cribrigerum* n. sp. Compound cribriform gland.
18. *Neolecanium cribrigerum* n. sp. Anal plates and ring.
19. *Neolecanium cribrigerum* n. sp. Dermal processes.



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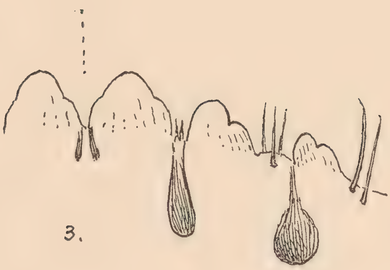

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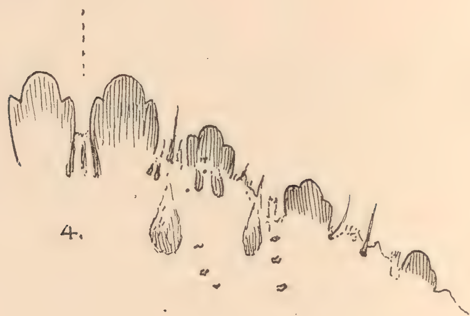

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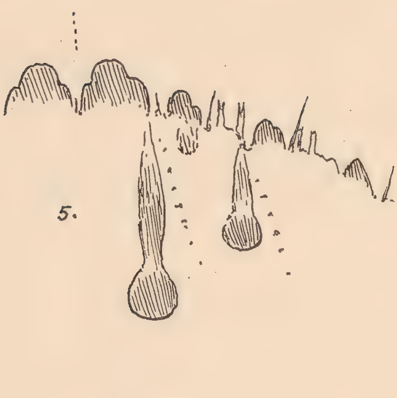

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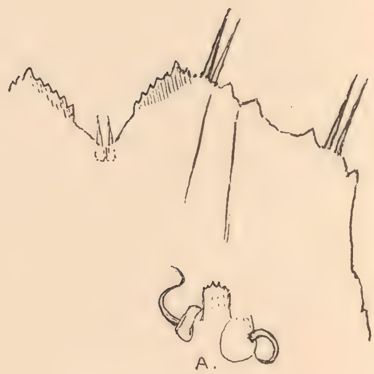

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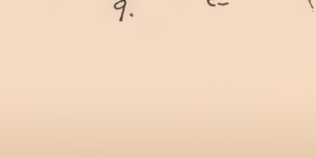

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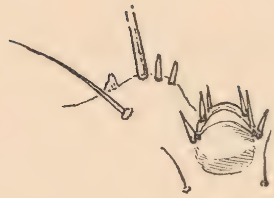

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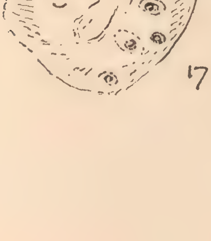

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Article III.— GASTROPOD MOLLUSCA FROM THE TERTIARY STRATA OF THE WEST.

By T. D. A. Cockerell.

A study of the Land and Freshwater Mollusca of the Rocky Mountain Tertiary strata leads to the expected conclusion that freshwater species have a greater range in time than terrestrial ones. More careful analysis of the evidence, however, indicates that this opinion is not so well supported as it at first seems to be. Successive groups of strata will contain representatives of the same genera of freshwater shells, while the land shell fauna found will usually show much generic diversity from period to period, in spite of the fact that most of the genera concerned have persisted down to the present day. This means, of course, that the terrestrial forms, though probably more numerous and diversified than the aquatic, are not so likely to be preserved. Thus we have in many cases a fairly representative showing of the freshwater genera, but only odds and ends of the terrestrial series.

It must also be noted that freshwater forms often fail to show very marked external features distinguishing allied species, and it is always possible that apparently long-lived types may in reality be composite, although we are not able to divide the material before us.

Three species of *Viviparus*, represented in the material before me, appear to extend from the Paleocene (whence they were described) well into the Eocene.

(1.) *V. trochiformis* (Meek & Hayden). Torrejon Formation, East Fork Torrejon Arroyo, New Mexico (Am. Mus. Nat. Hist., Exp. 1913); and also from the Wasatch at Ojo San José, New Mexico, many specimens (*Stein;* July 11, 1912).

(2.) *V. leidyi* (Meek & Hayden). Three lots from Clark's Fork Basin, Wyo., in the Sand Coulee Beds, collected by Granger and Stein. Three miles east, three miles southeast, and five miles southeast of the mouth of Pat O'Hara Creek.

One of the last lot is large, with aperture preserved; it is remarkable for the long aperture, which at once distinguishes it from *V. wyomingensis.* Aperture 23.5 mm. long; top of aperture to apex of spire 17.5 mm.; same length of spire on central axis 14.5 mm. Upper whorls only slightly convex.

(3.) *V. retusus* (Meek & Hayden). Many specimens, not very well preserved, from San Coulee Beds, head of Big Sand Coulee, Wyo. (*Granger and Stein*, Sept. 9, 1912).

Another species which seems to be long-lived is *Goniobasis tenuicarinata* (Meek & Hayden); a young but characteristic specimen was found by Granger and Stein in the Torrejon Formation, East Fork of Torrejon Arroyo, New Mexico, in July, 1912.

Goniobasis carteri Conrad (apparently a valid species) seems to be highly characteristic of the Wasatch; it was found both in the typical Knight Formation near Evanston, Wyo. (bluff north of railway at Knight Station, *G. Olsen,* June 14, 1906), and at Ojo San José, New Mexico (*Stein;* July 11, 1912). So far as we know at present, this shell does not appear before the Wasatch, and is therefore likely to be especially valuable for stratigraphical purposes.

Oreohelix megarche C. & H. and *Grangerella sinclairi* (Ckll.) are the best indicators of the Sand Coulee Beds (Lower Eocene). *G. sinclairi* is very abundant, and comes from three miles east and five miles southeast of mouth of Pat O'Hara Creek, and from the head of Big Sand Coulee, all in Clark's Fork Basin, Wyo. (*Granger and Stein*). *O. megarche* is also common at the various localities, but occurs also in the Wasatch of Big Horn Basin.

Terrestrial Species.

Grangerella n. g. (Bulimulidæ.)

Shell conic-subglobose, with about seven whorls; spire obtuse, sutures scarcely impressed; body-whorl broadly rounded, not at all keeled or angulate; umbilicus small but distinct; sculpture consisting of fine oblique riblets, about 6 to a mm. a short distance before the aperture. The last whorl broadens and is deflected upwards at the end, and the wide aperture is directed obliquely upwards, having about the same direction as the outer side of the shell; the thick lip, surrounding the aperture, has its upper angle produced, and actually extending a little above the level of the apex of the spire, while the lower inner corner extends a little below the periphery of the last whorl. Whether there are teeth in the aperture cannot be ascertained. There is no constriction on the outer side of the last whorl.

Grangerella megastoma n. sp.

Alt. 9 mm.; diam., max. 14, min. 9.75 mm.; aperture (outside measurement), long. 8, lat. 6 mm.

Sand Coulee Beds (Eocene); head of Big Sand Coulee, Clark's Fork Basin, Wyoming; Sept. 6 to 7, 1912 (*W. Granger*).

This remarkable species resembles *Boysia sinclairi,* from the same beds, but has the spire less elevated, and the aperture reaching to the apex, instead of to the fourth whorl. It is also a larger shell.

Only one specimen is before me, but it is possible that some of the very imperfect specimens referred to *B. sinclairi* belong here.

1.

Fig. 1. *Grangerella megastoma* n. sp. Three views of type.

It seems advisable to regard this as a distinct genus of Bulimulidæ. It agrees with *Boysia* in many respects, but the aperture is different, and more like that of some of the neotropical genera, such as *Zaplagius,* especially *Z. navicula* (Wagn.). The orientation of the aperture suggests an alliance with *Anostoma* and *Tomigerus.*

The species described as *Boysia sinclairi* and *B. phenacodorum* may be known as *Grangerella* (?) *sinclairi* (Ckll.) and *G.* (?) *phenacodorum* (Ckll.), since they are more likely to be congeneric with the genus now described than with true *Boysia.* Specimens with complete apertures would enable us to place them more exactly.

Eucalodium eophilum n. sp.

Shell (as preserved) broadly conoid, decollate, showing six whorls; whorls scarcely inflated; last whorl preserved strongly angulate at the periphery until about 7 mm. of the aperture, when the angulation is lost. Length 15.25 mm., width of last whorl 11, of penultimate whorl 9 mm.; length of aperture (measured obliquely) 9 mm. Surface of shell not preserved. In the apical region it can be seen that there is a spiral thickening, presenting a sharp edge around the axis, apparently much in the manner of the modern shells.

2.

Fig. 2. *Eucalodium eophilum* n. sp. Type.

Sand Coulee Beds (Eocene); three miles east of mouth of Pat O'Hara Creek, Clark's Fork Basin, Wyoming; Sept. 18, 1912 (*W. Granger*).

Although this is evidently immature, and lacks the surface sculpture, it appears to be a true *Eucalodium,* related to the living *E. decollatum* (Nyst). The apex was doubtless decollate in life.

Helix veterna veternior n. subsp.

Alt. 11.5, max. diam. 17 mm.; whorls nearly five, last whorl large, broadly rounded, not keeled or angled; spire low, about as in *Helix hortensis*, which the whole shell resembles in shape; surface smooth, without any spiral lines, and with only very weak oblique striæ marking the lines of growth; apex quite smooth, without riblets; lip thin, but columella rather stout; no umbilicus.

Fig. 3. *Helix veterna veternior* n. subsp. Showing variation; the middle one is the type.

Variety a. Spire depressed.

Variety b. Spire elevated, conoidal.

Sand Coulee Beds (Eocene); five miles S. E. of mouth of Pat O'Hara Creek, Clark's Fork Basin, Wyoming: 1912 (*Granger and Stein*).

In its typical form, of which two specimens are before me, apparently more or less immature, this looks like a distinct species. Variety b, however, is much like *H. veterna.* There is a series of species, consisting of *veterna* Meek & Hayden, from the Wind River Eocene, *riparia* White, from the Green River Eocene, and *leidyi* Hall and Meek, from the Oligocene, which are so closely related that from the shells alone they are scarcely separable. I examined the types of these in the U. S. National Museum, and made the following notes:

Helix leidyi *Hall & Meek.*

2012 (Types). White R., Nebraska. Agree with those discussed and figured in Bull. Amer. Mus. Nat. Hist., xxxi, p. 232, pl. xxii.

13303. Determined as *leidyi* by Marcou. Salt Lake City, Utah. Seems correct.

Helix veterna *Meek & Hayden.*

1975 (Types). Wind River Valley. I could not distinguish this from *leidyi.* Both species show the same variation in the height of the spire as was noted in the Amer. Mus. N. H. series of *leidyi,* but each presents all necessary intermediate forms, and the difference is partly due to compression, though not wholly so by any means.

Helix riparia *White.*

8881 (Type). Eight miles below Green River City, Wyoming. Internal cast, with fragments of outside, indicating rather coarse flattened ribs. Looks like a young *veterna-leidyi,* of the form with higher spire; perhaps differs by less elongated aperture, and outline of upper side of last whorl in front view seems more oblique than in *veterna.* On the whole, this appeared not to be a distinct species.

We thus have a general type extending from the Sand Coulee Beds

(Lower Eocene) through the Wind R. and Green R. into the Oligocene. Selected specimens look like very distinct species, but there seems to be a great amount of variability, which is about the same in character and degree in the oldest as in the latest representatives. We are not in a position to assert positively that all these shells represent a single species (for which the oldest name is *veterna*), and it is better to treat them as distinct, or at least to give them subspecific rank.

Helix peripheria White (8882 = type), from the Eocene, Valley Range west of Gunnison, Utah, is an internal cast, with fragments of shell showing irregular flattened rib-striæ. It looks immature; there are only about four whorls; apex lost. It is not the young of *Glyptostoma spatiosum;* the upper whorls are too small by far.

Pleurodonte eohippina n. sp.

Shell flattened, lenticular, very acutely keeled; aperture rather narrow, columella and inner wall with a heavy callus; no umbilicus; peristome with a well-developed basal lamina. Alt. 5.5, max. diam. 12.5 mm.; length of aperture about 6.5 mm.; spire about 1.5 mm. The spire has been worn down, so that the number of whorls cannot be ascertained; at first sight the spire seems to be covered by a thin callus, but this is surely the effect of wearing. A small part showing the sculpture, of rather well-marked but irregular riblets, about five to a mm., is preserved just behind the aperture. The outer upper part of the peristome is lost.

Fig. 4. *Pleurodonte eohippina* n. sp. Type.

Sand Coulee Beds (Eocene); head of Big Sand Coulee, Sept. 9, 1912 (*Granger and Stein.*)

This appears to be a true *Pleurodonte,* of the *Labyrinthus* type, now confined to the Neotropical Region.

Freshwater Species.

Physa bridgerensis *Meek,* variety a.

Imperfect specimen, 15 mm. long; three miles east of mouth of Pat O'Hara Creek, Clark's Fork Basin, Wyo., Sept. 18, 1912 (*W. S.*).

Imperfect, crushed, specimen, 17.5 mm. long; head of Big Sand Coulee. Wyo.; Sept. 6–7, 1912 (*W. G.*). These have very fine, weak, vertical striæ; They probably represent a species of the type of *P. bridgerensis*, but smaller, they are however too imperfect to permit the recognition of any satisfactory diagnostic characters.

I examined a *P. bridgerensis* (9001, near Fort Bridger) in the U. S. National Museum. It has a form rather suggestive of the *P. acuta* group; length 38 mm.; quite distinct from *P. pleromatis* by the long spire; vertical growth striæ fine, not inclining to large flat bands as in *pleromatis;* a heavy callus on inner side of aperture.

Campeloma calamodontis n. sp.

Shell about 33 mm. long and 23 broad; whorls about five, strongly shouldered, the suture deep, outer face of whorls vertical, flattened; lip (as shown by lines of growth) not markedly sinuous; shell rather thin, smooth, without evident sculpture; no trace of spiral lines or ridges.

Fig. 5. *Campeloma calamodontis* n. sp.

In purple-stained rock, Wasatch (Eocene), at Ojo San José, New Mexico (*Stein*, July 16, 1912). Several specimens.

This has all the appearance of a *Campeloma,* rather closely resembling the modern *C. ponderosum* Say, but apparently thinner, with much more flattened whorls.

It resembles *C. multilineatum* (Meek & Hayden), but the whorls are more broadly shouldered, and although the surface is well preserved, there are no spiral lines. The lip is straighter than in some of the species (*e. g. C. macrospira* Meek), but not more so than may be seen in living shells. In one specimen the whorls appear not to be shouldered, but this is due to compression and fracture.

There is a curious resemblance to White's figure of an internal cast of *Viviparus panguitchensis* White, but our shell shows the surface, without the sculpture or subbasal angulation of that species.

56.4.1U(118:78.7)

Article IV. — NEW SPECIES OF UNIO FROM THE TERTIARY ROCKS OF WYOMING.

By T. D. A. Cockerell.

Among the rather numerous specimens of *Unio* (sens. latiss.) collected by the American Museum expeditions in Wyoming, I find material representing four apparently new species. Although the taxonomy of the Unionidæ, even with living species, is so difficult as to give rise to endless controversy, I have some confidence in the validity of the species now described. At the National Museum, thanks to the kindness of Dr. Dall, I have been able to study all the previously described Eocene (exclusive of Paleocene) Rocky Mountain species, with the exception of *U. rectoides* White. The Fort Union beds (Paleocene) contain a very rich and varied Unionid fauna, consisting of 23 known species, described by Whitfield, White and Meek. It is an astonishing fact that this fauna, in its most characteristic elements, disappears somewhere about the middle of the Fort Union (as understood by Knowlton[1]), at about the same time as the dinosaurs. The dinosaurs have disappeared from the earth, but the Unionid fauna of the early Fort Union, in all its major features, survives in great abundance in the Mississippi Valley. In the Rocky Mountain region it has entirely gone, except that it has spread west to some extent in the rivers crossing the plains; this disappearance took place long ago, leaving in the Eocene only a few generic or subgeneric units, which eventually died out. Knowlton (Proc. Wash. Acad. Sci., XI, p. 232), discussing the possible reasons for the disappearance of the dinosaurs, concludes: "no more plausible theory occurs to the writer than that they were suddenly removed by epidemic disease, so many examples of which among recent animals have been given by Professor Osborn." This, obviously, will not explain the case of the Unionidæ, and we naturally think rather of movements of the earth, which drained the extensive waterways and produced conditions equally unfavorable to the Unionids and the dinosaurs. Knowlton, however, says "the waters were not drained; for sedimentation was continuous." It must be recalled that a very slight change of level would suffice to produce great changes in the water systems, and it certainly appears that the vast mass of

[1] It is not intended to express any particular opinion as to the lower limit of the Tertiary in using Knowlton's nomenclature. There appears to be no sharp line of demarcation between the Cretaceous and Tertiary in the Rocky Mountains, and since the limit thus becomes a matter for arbitrary decision, the question has no bearing on the biological argument.

sediment, much of it relatively coarse, indicates a regular orogenic movement. Should this be the real cause of the faunal change, we may ask ourselves whether the dinosaurs did not perhaps persist to a still later period in the lowlands eastward, where conditions have not been so favorable for the preservation of their remains?

Unio grangeri n. sp.

Shell very large, thick and inflated, rather coarsely sculptured with growth lines, but without nodules or ridges; anterior end obtusely rounded; dentition very heavy; muscle-scars deep; pallial line deep anteriorly. Represented by both valves, which are however much broken, with the posterior end missing. As preserved, the length is 140 mm.; it was doubtless originally not less than 180; depth about 95 mm., and width in middle about 85 mm. The lower anterior part of the shell is 10 mm. or more thick, but posteriorly the shell is thinner, about 3 mm. near the broken hind

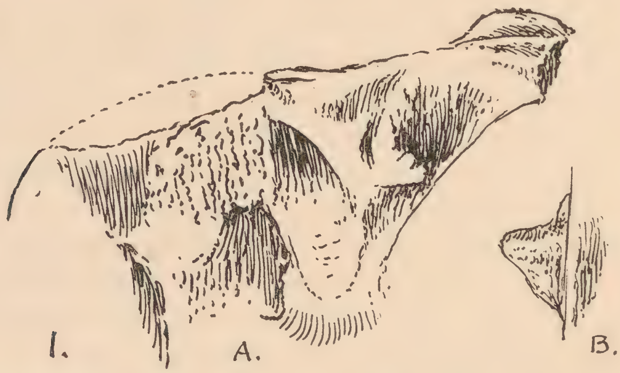

Fig. 1. *Unio grangeri* n. sp. *A*, Dentition of right valve, from within; *B*, same from above.

margin. The general outline is oblong, much as in *Lampilis ligamentina* (Lam.), but the swollen shell rather suggests *L. ventricosa* (Barnes). The umbones are not prominent (whatever sculpture they may have had is lost), and the dentition is of the *Lampsilis* type, with a very large thick posterior pseudocardinal on the right valve. The impression of the anterior retractor pedis muscle is large (14 mm. long) and very deep. It is fully 10 mm. distant from the upper end of the pallial line.

Washakie, horizon B; Haystack Mts., Wyoming, north side, half way up, Sept. 20, 1906. (*Paul Miller.*) Named after Mr. Walter Granger, who has given us a good account of the Haystack Mtn. locality (Bull. Am. Mus. N. Hist., XXVI, pp. 13–23).

This is probably a *Lampsilis*. Its great size and ventricose form readily distinguish it from previously described Tertiary Unionidæ of the Rocky Mountains.

Unio eomargaron n. sp.

Shell elliptical, with the ends broadly rounded, the lower margin (except toward the ends) straight, the upper nearly so; beaks (no sculpture visible) not far from anterior end, little prominent; valves only moderately convex, little flattened posteriorly; growth lines distinct, but no other sculpture; shell only moderately thick, in some specimens brilliantly pearly-iridescent; dentition broad but not heavy (left valve), resembling that of *U. washakiensis* Meek. Length 60 mm., depth about 32.5, width about 22.

Eocene; head of Big Sand Coulee, in coarse friable greenish sandstone, in numbers (*W. Stein,* Sept. 8, 1912). Clark Fork Beds. They are also labelled "Ralston."

This is certainly allied to *U. washakiensis* Meek, but is a lighter shell, with the umbones rather more posterior, and the posterodorsal region less elevated. I examined *U. washakiensis* Meek in the U. S. National Museum,

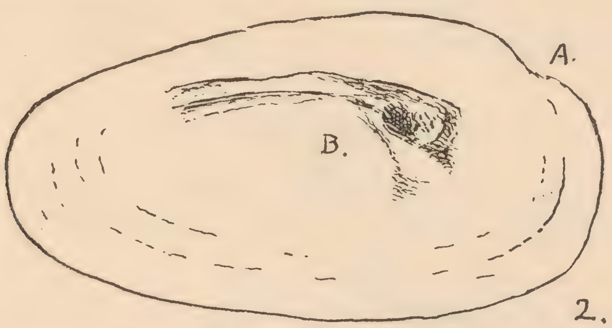

Fig. 2. *Unio eomargaron* n. sp. *A*, Outline of shell; *B*, dentition of left valve.

and noted as follows: "A large quantity of material, Wyoming and N. W. Colorado (near Raven Park and White River Valley). However the specimens from Washakie Station appears to me to be different from the rest; one of these (Washakie Sta., 18996) shows remnants of beak sculpture which was certainly plicate (undulate). The shell is very thick and deep, with heavy teeth; only the Washakie Sta. specimens show the hinge. All the other so-called *washakiensis* are longer, more parallel in outline, rather *U. clinopisthus*-like shells. They may be the same, but it seems doubtful. One young one (18677, eight miles below Green River Station) shows strongly plicate (undulate) beak sculpture. The Colorado specimens seem to be the same as this 18677, but they are all small, and apparently immature. It is not quite clear that the Washakie Sta. specimens are different from *U. haydeni.*"

With regard to *U. haydeni* Meek, I noted as follows at the U. S. National Museum: "8869 (Cotypes); near Fort Bridger, Wyo.; deep, flattish species, rather reminding one of *U. littoralis;* no beak-sculpture visible. 699 includes a broader (wider) specimen. 18695 is a great lot of *haydeni* from near Fort Bridger; it keeps the characters well, except that some are wider. Striation quite coarse."

The sketches I made show that the species is unusually flattened, or when broader has the posterior end flattened, so that the outline, seen from above, is unlike that of *U. eomargaron.* The straight (oblique) posterior slope is also quite unlike that of *U. eomargaron.* The straight lower edge separates the new species from *U. rectoides* and *U. shoshonensis. Unio shoshonensis* White, at least as represented in the National Museum from Henry's Fork, is a quite thick, deep species, with the umbones strongly undulate-plicate, with double loop in *U. mendax* style, the anterior part of loop largest. The dentition is not quite like that of *washakiensis.*

Some *shoshonensis* (det. Marcou, apparently correctly) are from the Green River Group, Dry Mts., N. W. Colorado (13223).[1] These have the shell 4 mm. thick. *U. shoshonensis* is less compressed posteriorly than *haydeni,* it is in fact quite a ventricose species.

Unio didymictidis n. sp.

Shell oblong, the outline almost as in *Lampsilis ligamentina,* except that the shell is not so deep posteriorly, and the lower margin consequently is not oblique; denti-

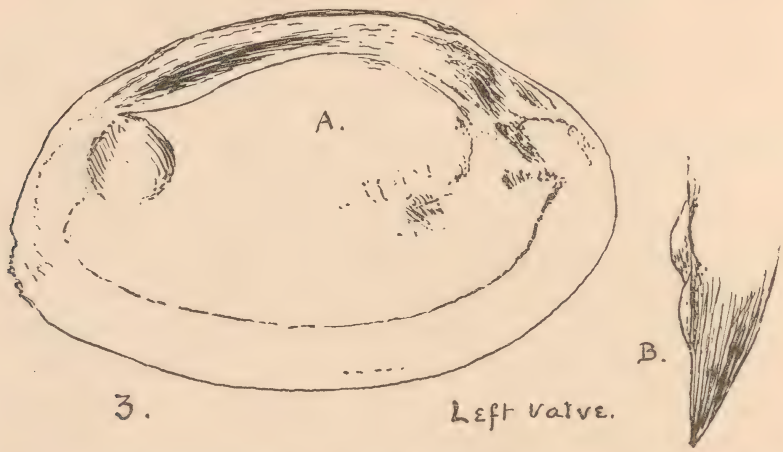

Fig. 3. *Unio didymictidis* n. sp. *A*, Left valve, from within; *B*, anterior end, from above.

tion heavy, the posterior pseudocardinal thick and obtuse (evidently somewhat worn); umbones not at all prominent, too worn to show sculpture; shell thick,

[1] Shells labelled *U. clinopisthus* White (det. Marcou), from Green R. Group, near Raven Park, Colorado (8876) are not that species, but are probably *haydeni,* so far as the poor material shows. A lot of shells from Henry's Fork are genuine *clinopisthus.*

growth-lines distinct, but no ridges or nodules. Length 69.5 mm.; height 44; breadth about 27 mm.; length of hinge-lamellæ about 28 mm.; level of umbones (vertically) from level of anterior margin about 21 mm.; anterior end of pallial line from margin of shell 8.25, from anterior retractor pedis 4 mm.; width of scar of posterior adductor 10.5 mm. Seen from above, the lateral outline of the anterior end of the shell is entirely convex, without the flattening due to compression which is conspicuous in *U. sinopæ.*

Wasatch Eocene, Gray Bull beds; north side of Dorsey Creek, nine miles from St. Joe, Big Horn Basin, Wyo. (*G. Olsen,* October 1, 1911). Found with a quantity of *U. wasatchensis,* from which it is readily known by the thick shell and heavy dentition. The umbones are less prominent than in *U. shoshonensis,* but the dorsal margin is convex as in that species.

Unio sinopæ n. sp.

Shell thick, with very heavy, broad dentition; growth lines strong, but no nodules or ridges; umbones too worn to show any sculpture; anterior end compressed, so that when seen from above the anterior lateral outline is slightly concave

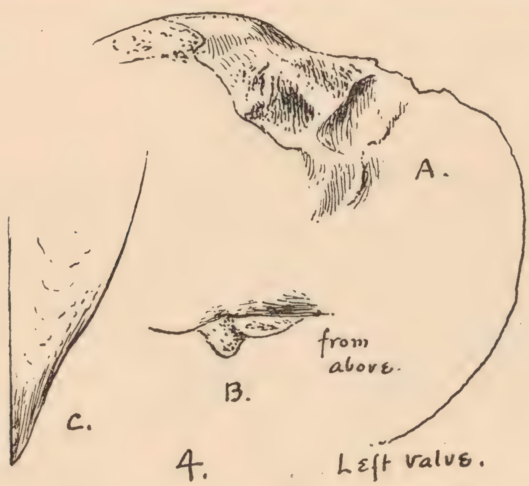

Fig. 4. *Unio sinopæ* n. sp. *A*, Dentition of left valve, from within; *B*, same from above; *C*, anterior end, from above.

a short distance behind the margin. Umbones about 35 mm. from anterior margin; pallial line weak, its anterior end 14 mm. from margin; anterior margin broadly rounded. The shell is represented only by the anterior and middle parts, but it evidently was over 100 mm. long and somewhat over 50 deep. The dentition (left valve), with a large subquadrate fossa between the pseudocardinals, is quite distinctive.

Wasatch Eocene; North side Dorsey Creek, 9 miles from St. Joe, Big Horn Basin, Wyo. (*G. Olsen,* October 1, 1911). Gray Bull beds. Found with *U. wasatchensis.*

Unio leanus *Meek.*

I take occasion to note that this name is not really preoccupied, the recent species being *U. leai.* Consequently the name *U. meekii* White is not required. I have examined cotype material in the National Museum, from Church Buttes, Wyoming. It is a heavy species with large teeth, represented by five internal casts and one fragmentary shell, which is very thick. The sculpture cannot be made out.

A species represented by casts in bright green rock from the Bridger Beds at Fort Bridger, Wyo. (Amer. Mus. N. H. Exp., 1893) may be compared with *U. leanus,* but is evidently distinct. It is not in a condition for description.

59.7,55A(81)

Article V.— A NEW CHARACIN FISH FROM BRAZIL.

By John Treadwell Nichols.

The American Museum of Natural History has recently been presented by Mr. W. L. Brind of Bergenfield, N. J., with an aquarium fish said to come from Manaos, Brazil, which has not previously been described.

Aphyocharax analis sp. nov.

The type and our only specimen, No. 5073, American Museum of Natural History, is 44 mm. long to base of caudal; head 4.9 times in this measure; depth 3.7; eye 3 in head; snout 4.5; maxillary, 2.6; least depth of caudal peduncle 1.8. Body strongly compressed, head short, eye large, mouth oblique, dorsal high, anal long and falcate, its front rays curved backward. Dorsal base equal to depth of caudal peduncle, its longest ray slightly less than depth of body; anal base 2.7 in standard length; its longest filamentous ray slightly greater than depth of body. Dorsal 10, anal 30.

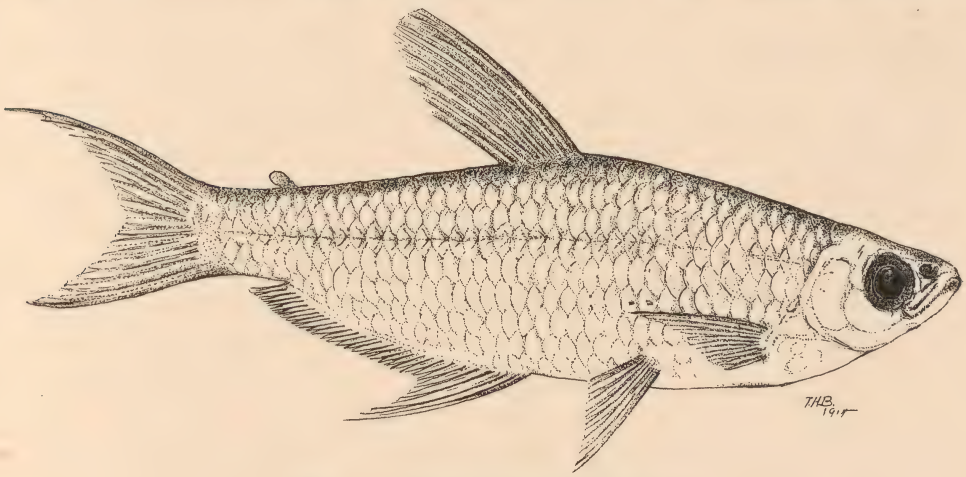

Fig. 1. *Aphyocharax analis* sp. nov.

Pectoral reaches past origin of ventral, ventral past origin of anal. The jaws when examined were somewhat broken, which made it difficult to study the teeth. A row of moderate cusped teeth on premaxillary and front of mandible; sides of mandible with smaller conical teeth. Almost the entire edge of the maxillary with conical, slightly recurved teeth, about 7 large ones. Scales in 35 cross series, the lateral line on about 11 anterior scales only. Color in spirits pale, more or less dusky along mid-dorsal line; no noticeable markings.

From *Aphyocharax filigerus* Cope (depth 4.25, anal 28, scales 38), the type of which is figured by Fowler in Proc. Philadelphia Acad. Sci. for 1896,

p. 334, the present species differs in its slightly longer anal, greater depth, fewer scales. It is more compressed, the pectoral region deeper, the maxillary more vertical, not extending back so far relative to the eye. It resembles more in appearance the monotypic genus *Prionobrama*, *Prionobrama madeiræ* Fowler, figured in Proc. Philadelphia Acad. Sci. for 1913, p. 536. It is less deep than this latter with larger scales, fewer anal rays and cusped instead of simple teeth. Possibly the dental difference is given undue weight in placing *analis* in *Aphyocharax* rather than *Prionobrama;* it is allied to *filigerus*, but resembles very little other species of *Aphyocharax* with which it has been compared.

59.82:14.78,7

Article VI.— NOTES ON PTILOSIS, WITH SPECIAL REFERENCE TO THE FEATHERING OF THE WING.

By W. DeW. Miller.

CONTENTS.

During the past few years the writer has had the opportunity of examining many specimens of birds in the flesh received by the American Museum of Natural History from various sources, chiefly from the New York Zoölogical Park. These represented a majority of the orders and suborders and most of them were utilized for skeletons, affording an excellent chance to examine certain points in the external anatomy, particularly the feathering of the wing, that cannot be satisfactorily studied in dried skins without injury to them. My observations have been supplemented by examination of skins and mounted specimens. The present paper consists mainly of an enumeration of such of my determinations as are at variance with the published statements.

Eutaxy and Diastataxy.— First may be considered the presence or apparent absence of the fifth secondary, resulting in the arrangements known as eutaxy and diastataxy, or formerly as quintocubitalism and aquintocubitalism.

Conflicting statements have been made regarding the arrangement in the Screamers and the Megapodes. I find by careful examination of three fresh specimens of *Chauna chavaria* and a discarded mounted *Megapodius cumingi* that in these particular species at least a superfluous greater covert overlies the space between the fourth and fifth secondaries, or, in other words, that they are diastataxic. *Chauna,* therefore, differs from *Anhima* (*Palamedea*) which Beddard and Mitchell (P. Z. S., 1894, p. 536) state is eutaxic, and the Megapodes differ in like manner from the rest of the Gallinæ.

It is perhaps hardly necessary to repeat that the Flamingos, as shown by two fresh specimens of *Phœnicopterus roseus,* are typically diastataxic. This confirms the determinations of Sclater, Pycraft and Gadow, the statement of Wray to the contrary being unquestionably erroneous.

The Pigeons, as is now well known, possess both styles of wing. I have had many genera for examination and append a list arranged according to this character.

Columbula, and *Lophophaps,* also the first and third species of *Geopelia,* are added on the authority of Dr. Mitchell.

Diastataxic	*Eutaxic*
Columba arquatrix	Geopelia tranquilla
" flavirostris	" striata
" palumbus	" cuneata
Ectopistes migratorius (Skin)	Scardafella inca
Zenaidura macroura (Skin)	Columbula picui
Zenaida zenaida (Skin)	Chæmepelia minuta
Streptopelia bitorquata	Claravis pretiosa (Skin)
" capicola	Chalcopelia afra
" vinacea	Phaps chalcoptera
Spilopelia chinensis	Lophophaps plumifera
Œna capensis	Ocyphaps lophotes
Chalcophaps indica	Phlegœnas luzonica
Leptotila verreauxi	Leucosarcia picata
Geotrygon montana	Starnœnas cyanocephala
Calœnas nicobarica	
Didunculus strigirostris	

The Peristeridæ, to which belong all the 24 genera above enumerated, except *Columba, Ectopistes* and *Didunculus,* are divided by Sharpe into seven subfamilies. The two largest of these contain both eutaxic and diastataxic genera. It will be observed, however, that as a rule the most closely allied genera (indicated above by brackets) agree in this respect, an exception being *Chalcopelia* which differs from its supposedly near allies *Œna* and *Chalcophaps.*

The great Gull-Plover group, or Laro-Limicolæ, has been considered as universally diastataxic. It is therefore of considerable interest to find that the American Woodcock (*Philohela*) is eutaxic. Examination of one fresh specimen and two skins prove this beyond a doubt. It would naturally be expected that *Scolopax* might agree in this point with *Philohela,* so I was surprised when inspection of mounted birds showed both *Scolopax* and *Gallinago* (*G. delicata*) to agree with the vast majority of the group in the presence of the extra fifth covert fully developed. *Philohela* therefore gains a generic character, additional to those of the attenuated outer primaries, narrower outer rectrices and more graduated tail. It is not safe, however, to assume that *Scolopax saturata* (lately separated by Mr. Gregory Mathews as *Parascolopax*) and *Neoscolopax rochusseni* resemble *Scolopax rusticola* in this respect and both should be investigated.

This isolated case of the eutaxial wing in a large and varied diastataxic group is further evidence of the derivation of the former type from the latter.

The Rollers (Coraciidæ) are said by Gadow and by Beddard to be eutaxic. Examination of two fresh and one mounted specimen of *Coracias indicus* (on which genus Gadow's determination was based) one fresh *C. garrulus,* and a mounted specimen of *Eurystomus afer* prove that the typical Rollers (Coraciinæ), at least, are diastataxic. *Corapitta pittoides* is apparently eutaxic but there was available only a mounted bird that did not permit of satisfactory examination. *Leptosoma* has not been investigated.

Sclater (Ibis, 1890, p. 80) enumerates among the genera of Anisodactylous Picarians that he had found on examination to be "quintocubital," *Podargus* and *Steatornis.* Dr. Gadow (P. Z. S., 1888, p. 659) marks these two genera as undetermined. In his table of characters (Tierreich, 1893), and in Beddard's diagnosis of the group, the Caprimulgi (including *Podargus* and *Steatornis*) are stated to be diastataxic. I have carefully examined one wing of a mounted specimen of each of the three following species: *Podargus strigoides, Batrachostomus stellatus* and *Steatornis caripensis* and find each one clearly diastataxic, thus agreeing with the Caprimulgidæ. Not only is the superfluous fifth covert present but the peculiar proportions of the coverts observable in many birds with this type of wing is very evident in at least the first two genera, the fifth greater covert being disproportionately longer than the fourth, while the sixth is abruptly shorter than the fifth.

The Hummingbirds (Trochilidæ) are divided by Ridgway (Bds. N. and M. Amer., Pt. V, p. 303) into three subfamilies, based on differences in the nasal operculum and in coloration:—Phœthornithinæ or Hermits, Trochilinæ, or typical Hummingbirds, comprising the vast majority of genera, and Lophornithinæ or Coquettes, etc.

Gadow (1888 and 1893) marks the Hummingbirds eutaxic and Sclater (1890) states: "In the Trochilidæ the fifth *c. r.* is apparently present." Subsequent authors have universally given this family as eutaxic, doubtless relying on the above statements.

Two genera, *Phœthornis* (*P. guyi*) and *Glaucis,* both belonging to the first subfamily, prove to be eutaxic; but the following, all Trochilinæ, are diastataxic, as determined by very careful examination, and it is probable that the numerous remaining genera of the subfamily will be found to agree with them in this respect.

Patagona gigas	Chrysolampis elatus
Chlorostilbon sp.	Ensifera ensifera
Colibri iolotus	Boissoneaua flavescens
Oreotrochilus pichincha	Heliothryx sp.
Anthracothorax gramineus	

Of the Lophornithinæ I have examined *Lophornis helenæ, L. ornatus* and *L. magnifica* and find them diastataxic.

Here, then, is an additional character separating the Phœthornithinæ from the rest of the family.

For convenience of reference a list is given below showing our present knowledge regarding the occurrence of the diastataxic and eutaxic types of wing among Carinate birds. There is little doubt that further exceptions will be discovered of eutaxic forms in the diastataxic groups.

1. *Universally Diastataxic.*

Pygopodes	(Loons, Grebes)
Tubinares	(Petrels, Albatrosses)
Herodiones	(Herons, Storks)
Steganopodes	(Cormorants, Pelicans)
Phœnicopteres	(Flamingoes)
Anseres	(Swans, Ducks, Geese)
Accipitres	(Hawks, Vultures, Secretary-bird)
Ralli	(Rails)
Grues veri	(True Cranes, Limpkin)
Otides	(Bustards)
Lari	(Gulls)
Alcæ	(Auks)
Pterocletes	(Sand Grouse)
Megapodes	(Mound-builders)
Psittaci	(Parrots)
Striges	(Owls)
Caprimulgi	(Oil-bird, Frog-mouths, Nightjars)

2. *Groups containing both Eutaxic and Diastataxic forms.*

Columbæ	(Pigeons)	Numerous genera of each style.
Limicolæ	(Plovers, Snipe)	*Philohela* alone known to be eutaxic.
Anhimæ	(Screamers)	*Chauna* diastataxic, *Anhima* eutaxic.
Turnices	(Hemipodes)	*Pedionomus* diastataxic, *Turnix* eutaxic.
Coraciæ	(Rollers)	*Coracias* and *Eurystomus* diastataxic, *Corapitta* probably eutaxic.
Halcyones	(Kingfishers)	Several genera of each style.
Cypseli	(Swifts)	Mostly eutaxic; *Streptoprocne* and *Collocalia* said to be diastataxic. Dendrochelidonidæ (all?) diastataxic.
Trochili	(Hummingbirds)	Phæthornithinæ eutaxic, all others diastataxic.

3. *Universally Eutaxic.*

Tinami	(Tinamous)
Cracidæ	(Curassows)
Gallinæ alectoropodes	(Grouse, Partridge, Pheasants)
Opisthocomus	(Hoatzin)
Grues aberrantes	(Seriema, Trumpeter, Kagu, Sun-bittern, Fin-foot)
Coccyges	(Cuckcos, Plantain-eaters)
Meropes	(Bee-eaters)
Momoti	(Motmots, Todies)
Trogones	(Trogons)
Bucerotes	(Hornbills, Hoopoes)
Colii	(Mouse-birds
Pici	(Jacamars, Barbets, Woodpeckers, etc.)
Passeres	(Broadbills, Tyrant-birds, Ant-birds, Lyre-bird, Song-birds, etc.)

Metacarpal Primaries.— In the Tinamous and in all Neognathæ except the Grebes, Storks and Flamingos, the metacarpal primaries are six in number. In the three superfamily groups mentioned and in the Rheas they number seven. Gadow states that *Ciconia* is unique among the Storks in having but six metacarpal quills. I have carefully examined three fresh specimens of *Ciconia ciconia* and one of *C. boyciana* and in each case find twelve primaries of which seven grow on the metacarpus as in other Storks and five are digital (the outermost vestigial).

With this supposed exception eliminated the number of metacarpal quills becomes a constant character of some taxonomic value. It is probable that the larger number is the older condition as it seems hardly probable that the weak-winged Rheas and Grebes would have gained an additional primary. While it is obvious that the identity in number in these families and in the Storks is not the result of any close relationship between the three groups, it seems probable that the resemblance between Storks and Flamingos in this particular is an indication of affinity.

First Primary Covert.— In the great majority of birds the first greater upper primary covert, which lies between the first (innermost) and second primaries, is of normal size and form, closely resembling the second in all respects. I have found it decidedly reduced only in certain alectoropodous Gallinæ, in *Turnix* and in most Parrots. In these the first covert is less than three-fourths the length of the second, while in all other birds examined it exceeds three-fourths. In the Cracidæ (*Penelope* and *Ortalis*) and in the Megapodidæ (*Megapodius*) this covert is normal. In *Pavo* it is normal or nearly so; in *Ammoperdix* and in *Colinus*, though a trifle more than three-fourths the length of the next covert, it is distinctly degenerate. In *Gennæus, Phasianus, Syrmaticus, Chrysolophus, Caccabis* and *Cyrtonyx* it measures less than three-fourths (but much more than one-half) of the second. *Turnix* (*T. nigricollis* and *T. ocellata*) agrees with the latter.

The condition of this covert in the Psittaci is of particular interest as I believe it will prove of some assistance in the difficult problem of classification in this group. In the Cockatoos (*Cacatoës*,[1] *Eolophus*,[2] *Licmetis* and *Leptolophus*[1]) and in *Stringops* the first covert is normal in size, form and texture. In all other Parrots examined it is decidedly less than three-fourths the length of the second, often less than one-half, and is sometimes reduced to a mere tuft of down not one-third the second covert in length. This last stage is reached in *Charmosyna, Ara, Conurus* and *Conuropsis*, and the feather is nearly or quite as vestigial in *Trichoglossus, Vini, Anodorhynchus, Brotogeris, Pionus, Pionites, Poicephalus, Psittacula* and *Myiopsitta.*

In *Amazona, Rhynchopsitta, Psittacus, Palæornis, Agapornis, Aprosmictus* (*Ptistes* auct.), *Alisterus* (*Aprosmictus* auct.), *Tanygnathus* and *Melopsittacus* the reduction is carried not quite so far, and in none of them is the covert completely downy. It is least reduced in *Coracopsis, Pezoporus, Platycercus, Psephotus, Eos, Lorius* and *Nestor,* being considerably more than half as long as the second, less vestigial in structure, and firm, not downy, terminally. Between these several groups of species, there is, however, complete intergradation in the size and form of this covert.

It is obvious that the Cockatoos and the Owl Parrot branched off from the early Psittacine stem before the reduction in the first primary covert

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[1] As stated by Mathews (Novitates Zoologicæ, Vol. XVIII, pp. 11–13, 1911) *Cacatua* Vieillot and *Calopsitta* Lesson must be replaced respectively by *Cacatoës* Dumeril and *Leptolophus* Swainson on the grounds of priority. I cannot agree, however, with the contention that *Probosciger* Kuhl and *Conurus* Kuhl should be superseded by *Solenoglossus* Ranzani and *Aratinga* Spix. Though the older names were merely given to "sections" these are equivalent to subgenera and there seems to be no reason why they should not be accepted as such.

[2] The Rose Cockatoo, *Cacatoës roseicapilla*, is generically distinct from true *Cacatoës*, the proper name for the monotypic group being *Eolophus* Bonaparte (Rev. et Mag. de Zool., 1854, p. 155). The two genera differ conspicuously in the form of the wing and in coloration. In *Eolophus* the crest is shorter and broader, approached but, I think, not equalled by certain species of *Cacatoës*. In *Cacatoës* the secondaries are very ample reaching nearly to the tip of the wing which is broad and truncate, the ninth primary equal to or shorter than the sixth. In *Eolophus* the secondaries are shorter and smaller, and the terminal primaries are elongated resulting in a more pointed wing, the ninth quill much exceeding the sixth.

All the species of *Cacatoës* are wholly white, the inner webs of the remiges and rectrices always tinged with yellow or red, the crest and parts of the body plumage often marked or tinged with these colors. In *Eolophus* the back, wings and tail are gray, crest whitish-pink, rump grayish-white and underparts raspberry-red. According to Garrod (P. Z. S., 1874, p. 588) *Eolophus* has two carotid arteries, while *Cacatoës* has but one, but as Beddard records two present in both genera the number is in doubt.

Reichenow divides the short-tailed Cockatoos into two genera according to the form of the crest, placing the Rose Cockatoo in true *Cacatoës* characterized by a broad-feathered crest, the species with narrow, recurved crest feathers standing as *Lophochroa*. As *Eolophus* stands alone in form of the wing and in coloration this arrangement is certainly not a natural one. Mathews recognizes five segregates of the old genus *Cacatoës*, a degree of subdivision that to many will seem quite unnecessary.

began, and it is unlikely that this reduction took place independently in two or more groups. On this view the Cacatuidæ and Stringopidæ form a group, or two groups, equal in value to all other Parrots combined.[1] This is contrary to Gadow's scheme in which the suborder is divided into Trichoglossidæ with Nestorinæ, Loriinæ, and Cyclopsittacinæ, and Psittacidæ with Stringopinæ, Cacatuinæ and Psittacinæ. The Cockatoos are a strongly marked group. The entire absence of green or blue in any species is very striking and among other characters are the presence of a crest and, in the skull, a peculiar orbital ring.

The arrangement suggested does not appear to be contradicted by any other character and though it is here impracticable to pursue the subject further, it is evident that the first primary covert should be considered in any future attempts to elucidate the classification of the Parrots.

Vestigial Eleventh Primary.— My determination of the number of primaries differs from the figures given by Gadow (Tierreich, 1893) in the case of the Pigeons, Bee-eaters, Rollers, Barbets, Toucans and Woodpeckers.

Gadow states that the Pigeons have eleven primaries but I have failed to find even a trace of a vestigial eleventh quill in any of the twenty genera examined, including *Calœnas* and *Didunculus*. Mitchell [2] credits *Phlogœnas cruentata* (= *Phlegœnas luzonica*) with only nine primaries, but the two specimens examined prove beyond a doubt that in this species, as in other Pigeons, there are normally ten fully developed primaries.

In *Nyctiornis amictus* I find ten functional primaries and an extremely vestigial outermost, eleventh, only 5 mm. long. *Merops* has ten primaries, the tenth spurius; no trace of an eleventh.

In the typical Rollers and the three families of Pici above mentioned there is in each case a minute vestigial eleventh primary. Examination proves this to be the case in *Coracias indicus* and *C. garrulus*, *Eurystomus orientalis*, *Cyanops* sp., *Chotorhea corvina*, *Ramphastos ariel*, *R. brevicarinatus*, *Aulacorhynchus prasinus*, *Selenidera maculirostris*, *Colaptes auratus*, *Phlœotomus pileatus*, *Brachypternus aurantius*, *Campephilus principalis* and *Dryobates pubescens*. In the latter the vestige is but 2.5 mm. long, and in *Chotorhea* only 3 mm. It is quite possible, therefore, that in some members of the group the eleventh primary has entirely disappeared.

In his 'Birds of North and Middle America,' Part VI, page 451, Mr. Ridgway states: "Although the Momotidæ are said to possess 11 primaries, I have not been able to find more than 10 in any of the 7 genera." There is no doubt, however, that in *Momotus*, at least, there are 11 primaries. In

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[1] The Cacatuidæ and Stringopidæ are further mutually allied by the structure of the syrinx and its intrinsic muscle (Beddard).

[2] Journ. Linn. Soc. London, XVII, p. 213.

a fresh specimen of *M. subrufescens* recently examined, I found a vestigial eleventh (outermost) primary 8.5 mm. long, firm but not stiff nor acute; the shortened tenth quill 57 mm. long. In an individual of *M. lessoni* the "remicle" was 8 mm. in length. In the same work (p. 441) the number of primaries in the Todidae is given as "9–10," evidently taken from Gadow's table in the Tierreich. I have examined all the species of the genus and find 10 well developed primaries in each.

Alula.— The most remarkable alula among the numerous birds investigated is found in the curious Cuckoo, *Tapera.* In this bird alone is the first alula quill about equal to the third,[1] and the fifth much longer than the distance from its tip to the tip of the longest (second) feather. It is well known that in this bird the alula is unusually mobile and is used in display, being thrust out at an angle from the rest of the wing and across the breast. It is large and mobile also in other Cuckoos and in the Turacos. A nestling Yellow-billed Cuckoo (*Coccyzus americanus*) once observed by the writer raised the alula most conspicuously when disturbed. *Dromococcyx,* the nearest relative of *Tapera,* shows only a slight approach to the peculiar alula of the latter.

Psophia, the Trumpeter, is the only other genus examined in which the first alula quill is shorter than the second. In *Tapera* the quills are six (possibly only five) in number, five or six in *Geococcyx, Centropus, Pavo* and *Psophia,* six in *Turacus.* In many groups, as the Parrots and Hawks, there are only four feathers (all large and well defined in the two groups mentioned), and many Woodpeckers (as *Centurus* and *Dryobates*) and small Oscines have but three, of which the third is small.

It is stated that the Hummingbirds have but a single alula quill and that even this is sometimes wanting (Ridgway, Birds N. and M. Amer., Pt. V, p. 299). My observations do not confirm this statement. In *Patagona gigas* the distal quill is a lanceolate feather 14 mm. in length; next to this is a fairly stiff though not quill-like feather 7 mm. long, then a third feather $4\frac{1}{2}$ mm. long. On carefully cutting out the pollex these three feathers (and possibly a fourth smaller one) are all found to grow from well above the basal end of the bone. It seems to me therefore that they are alula quills beyond a doubt. In several other Hummers examined (as *Colibri* and *Anthracothorax*) at least two feathers must be considered as belonging to the alula, the second one differing greatly in length and shape from the narrow linear first quill.

Outermost Primary Covert.— A remarkable feature of the Trumpeter

[1] In *Chizorhis zonurus* (Musophagidæ) also the first feather about equals the third.

(*Psophia*) that I have found in no other bird is the abruptly enlarged outermost upper primary covert. In a specimen of *P. leucoptera* this covert was 82 mm. long, the next four respectively being 37, 45, 54, and 56 mm. As a rule this outermost covert is much shorter than the next.

Rectrices.— The number of rectrices in two genera of Jacamars, *Brachygalba* and *Jacamaralcyon,* is wrongly stated by Ridgway (Birds of N. and M. Amer., Pt. VI, p. 361) to be only "10 (the sixth pair wanting)," an error traceable at least as far back as the British Museum Catalogue of Birds (Vol. XIX, p. 161). In both these genera the outermost (sixth) rectrix is present, as in every other member of the family, but while in *Brachygalba* it is more reduced than in any other genus, in *Jacamaralcyon* it is scarcely smaller than in *Galbula.*

In the Woodpeckers and Wrynecks the tail-feathers number twelve, the outermost or 6th pair (as in the Jacamars) being reduced to a useless vestige, remarkable for its constancy. It is of interest to find that this pair of small rectrices, heretofore supposed to be invariably present, has been lost by *Campephilus pollens* and its place taken by the much reduced fifth pair. On account of this and other peculiarities *C. pollens* may be allowed generic separation under Malherbe's name *Megapicos.*

The Campephileæ are characterized in part by the unique form of the four middle rectrices which are much stronger than the remainder. The tail, at least in the American genera, is more strongly graduated than in other Woodpeckers. These peculiarities reach their maximum in *Megapicos* in which as a result of the great enlargement of the four middle tail-feathers the others have been much reduced and the vestigial sixth pair crowded out altogether.

Beddard states that he "found only ten rectrices in *Tiga shorei.*" I have not seen this species but judging by the form of the tail in the related *T. javanensis* it seems probable that the specimen examined by Beddard had lost a pair of its tail-feathers either by molt or accident. In any event additional specimens must be examined before the normal number of rectrices in this species can be regarded as settled.

The number of tail-feathers in the Motmots can now be regarded as definitely settled, the statements in the Tierreich (page 230) and British Museum Catalogue (XVII, p. 313) being erroneous. As correctly given by Mr. Ridgway there are only ten rectrices in every genus but *Momotus* which possesses twelve. In one of the three specimens of *Baryphthengus* examined, however, the right half of the tail has six rectrices, the sixth feather being of about the same relative size as in *Momotus.* The left side of the tail is imperfect.

Oil-gland Tuft.— Statements regarding the presence or absence of a tuft on the oil-gland prove erroneous or only partly true in the case of the Bucconidæ, Picidæ, Capitonidæ, and Momotidæ.

Although the Puff-birds (like the Jacamars) are usually credited with a nude oil-gland Gadow states that in some of them it is feathered. On examination of every genus of these two families I find that without exception the oil-gland is perfectly bare.[1]

Both in the Woodpeckers and the Barbets the oil-gland normally bears a tuft of down at its tip, and I am not aware that any exception to the presence of this tuft has been recorded. In each of these families, however, there prove to be several genera in which the oil-gland is nude.

Of the Woodpeckers all the genera with the exception of *Sapheopipo* and *Trichopicus* have been examined in this connection. In the majority the tuft of the oil-gland is of small size; fairly large however in the *Celeæ, Chrysophlegma mentalis* and *C. flavinucha, Megapicos pollens, Sphyrapicus* and *Hypopicus.* The genera in which this tuft of down is absent are the mutually allied forms, *Tiga, Brachypternus, Gauropicoides* and *Gecinulus,* but it is present in the related genera *Micropternus* and *Meiglyptes.*[2] In *Chrysocolaptes* the tuft varies from vestigial to absent even within specific limits. In the Barbets (Capitonidæ) we find a small, dense tuft in the four American genera and the seven genera of green Asiatic Barbets. In the very distinct brown *Calorhamphus* of the same region the tuft is thin and sparse. It is in the same condition in the African forms, *Xylobucco* and (probably) *Trachylæmus,* but is wholly wanting in *Heliobucco,* and the natural group of tooth-billed Barbets comprising the genera *Pogonorhynchus, Erythrobucco, Melanobucco, Lybius* and *Tricholæma.* The following genera (all Ethiopian)

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[1] I am strongly convinced that a primary division of the antiopelmous Picarians should be made into two groups, one containing the Bucconidæ and Galbulidæ, the other the Indicatoridæ, Ramphastidæ, Capitonidæ, Yungidæ, and Picidæ. This course was suggested by Stejneger (Standard Natural History) but Ridgway in his late treatment of the group, which he considers a suborder, Picariæ, divided it at once into four superfamiles: Pici, Capitones, Ramphastides and Galbulæ.

In view of the many radical differences between the Galbulæ and the remaining superfamiles, as compared with the few and comparatively unimportant differences between the Capitones and Ramphastides, or even between these and the Pici, it seems inevitable that the Galbulæ should be given higher rank.

Diagnostic characters of the latter are as follows: Nude oil-gland, well-developed cæca, two carotids, non-oscinine wing-coverts, only moderately deep temporal fossæ, thoracic hæmapophyses with lateral ventral enlargements, furcula with hypocleidum, ectepicondylar process of humerus absent. The metacarpus and distal end of metatarsus are both very different from the highly characteristic forms of the other families, and the plumage altogether lacks the bright red so universal in the Barbets, Toucans and Woodpeckers. If the antiopelmous forms are regarded as an order the two primary groups can be ranked as suborders; if, however, we begin with a suborder some less definite term, as section, must be used.

[2] On account of the bristly feathers covering the nostrils *Gauropicoides* and *Gecinulus* are widely separated by Hargitt (British Museum Catalogue) from the other genera above mentioned. They agree with *Tiga,* however, in the absence of the hallux and the large size of the sixth rectrix, as well as in the nude oil-gland, and in my opinion the six genera enumerated form a natural group.

have not been examined: *Gymnobucco, Smilorhis, Stactolæma* and *Viridibucco.*[1]

It is often stated that in the Motmots the oil-gland is nude, but both Gadow and Beddard record feathered as well as unfeathered oil-glands in this family. Gadow mentions no genera, and Beddard merely states that "in *Momotus* the *oil-gland* is quite nude; in *Hylomanes* and *Eumomota* the apex is furnished with a few small plumes." On examination of all seven genera I find a small but well-marked tuft in *Hylomanes, Aspatha, Eumomota* and *Electron.* In the remaining three genera the gland is usually perfectly bare, but close examination with a lens frequently reveals a very minute vestige of the tuft. This has been observed in *Momotus swainsoni, Baryphthengus* and *Urospatha,* and presumably occurs in other species of *Momotus.*[2]

Aftershaft.— It has long been supposed that in the Osprey (*Pandion*) the feathers are without an aftershaft, and time and again has this alleged

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[1] The commonly accepted classification of the tooth-billed forms above mentioned appears to represent the natural inter-relationships of the genera very imperfectly. *Erythrobucco* is so strikingly similar to *Pogonorhynchus* in coloration and general form, scarcely differing except in the absence of corrugations on the lower mandible, that the desirability of separating it generically is surely open to question. Whether or not it be kept apart, however, it seems necessary to restrict *Lybius* (type *L. tridactylus*) to the smaller, black-billed species, distinguishing the several white-billed species as *Melanobucco* (type *M. bidentatus*). Despite their simple bill and few bristles the latter are evidently more nearly related to *Pogonorhynchus* and *Erythrobucco* than to *Lybius.* They differ from the latter in larger size, longer tail, larger, distinctly double-notched, white bill, and in coloration, in all of which they agree with or closely approach the former genera. The coloration of the type of *Melanobucco* is remarkably similar to that of *Erythrobucco* and *Pogonorhynchus* with which it shares the tuft of narrow, elongated white dorsal feathers, and the thick almost truncate bunch of white feathers on each side of the body.

That these peculiarities of color and plumage were evolved independently is highly improbable, and it would be fallacious to consider *Melanobucco* as more nearly related to *Lybius* merely because of general agreement in the unspecialized bill and its bristles. Study of the geographical distribution confirms the naturalness of the arrangement suggested.

Since the above was written the second volume of Reichenow's "Die Vögel" has come to hand. This author combines *Erythrobucco* with *Pogonorhynchus* as above suggested.

[2] The four genera with tufted oil-glands have their center of distribution in Central America, three of them (all monotypic) and one species of *Electron* being confined to this region; the single remaining species of *Electron* ranges from Nicaragua to Ecuador. They are further characterized by the broad, depressed bill with very finely serrate tomia, and their average size is much less than that of the remaining species.

The latter possess a much narrower and deeper, coarsely serrate bill. While well represented in Central America one of the three genera (the monotypic *Baryphthengus*) is confined to Brazil. These two groups may well be regarded as subfamilies, the *Hylomaninæ* and the *Momotinæ.*

The Hylomaninæ show a marked approach to the Todidæ. This is evident in the depression of the bill and its fine serration, and in the tufted oil-gland. Furthermore, in *Aspatha* and *Hylomanes* the tomium is nearly straight and the middle rectrices of normal form, while in *Hylomanes,* which is by far the smallest member of the family, there is no tuft of black feathers on the chest. The geographical distribution is also significant.

In each of the subfamilies both normal and spatulate central rectrices occur. The intraspecific variation in this respect in *Urospatha martii* and *Electron platyrhynchus,* however, greatly reduces the taxonomic value of this character in the Motmots.

character been cited as diagnostic of the Pandionidæ among the typical Accipitres. In recently examining a fresh Osprey I was therefore surprised to find a perfectly distinct aftershaft with stiff, elastic shaft, on the feathers of the interscapulum, rump and crissum. A feather from each of these regions shows the following measurements of main feather (excluding barrel) and aftershaft respectively: 47 mm., 8.5 mm.; 39,8; 75,10. The plumage of the underparts in general has no aftershaft.

59.7(729.5)

Article VII.— FISHES NEW TO PORTO RICO.

By John Treadwell Nichols.

During the past summer (July 8–August 5), the writer spent four weeks in Porto Rico studying its fish fauna, incident to a biological survey of the island being made by the New York Academy of Sciences for the insular government. It seems best to postpone full publication of results obtained until there has been opportunity for the assembling of more complete data and further study of material, but to list the 22 species, no definite record of the occurrence of which is given in 'Fishes of Porto Rico,' Evermann and Marsh (Bull. U. S. Fish Commission for 1899 [1900]), is in order. Two of these 22 species are listed as new. Through the courtesy of the United States National Museum, and of Mr. Barton A. Bean of that institution, it has been possible to compare our specimens with material in Washington.

Galeocerdo tigrinus *Müller & Henle.*

The writer was shown a tooth of this species in San Juan. This is good, though not unimpeachable, evidence of its occurrence here. It is probably rare.

Carassius auratus (*Linné*).

The goldfish is said to be abundant at Isabella, in the northwest corner of the island. It has been recently placed in a small pond on the Governor's estate in the hills above Guayama, where it seems to be doing well.

Myrichthys acuminatus (*Gronow*).

A single small specimen was dredged in Condado Bay, July 21. In life the body was grayish above, pale below, everywhere with small bright yellow spots, those on the back and sides the nuclei of larger pale circles. Dorsal narrowly tipped with dark and then white; anal with white.

Sardinella sardina (*Poey*).

This species was the abundant herring in San Juan Harbor in July. Specimens were collected July 8 and 11.

Tylosurus euryops, *Bean & Dresel.*

Small needle-fish were common in San Juan Bay. A few specimens obtained are referred to this species, after comparing a specimen with a *euryops* of approximately the same size from Jamaica in the U. S. National Museum, which is marked as the type. The species is close to *timucu* (Walbaum) of which it may possibly be the young.

Doryrhamphus sierra sp. nov.

The type, No. 4840, American Museum of Natural History, was taken in drifted weed at the mouth of the Loiza River, east of San Juan, July 25, 1914. It is 79 mm. long to base of caudal; head 5.9 in this measure; depth 5.6 in head, snout 1.7, eye 8.8, postorbital part of head 3.5. Slender, snout long, tail very slender, tapering; ridges high, sharp, serrate, a moderate, thin, finely serrate, central keel, rising on the terminal half of the snout ends abruptly before the eye. A well marked keel flanking each eye above, serrate posteriorly; a short, low, serrate scapular keel. A similar, but longer one crosses the opercle, with three low backwardly radiating keels below it; a series of serrate mid-dorsal keels from behind the eye to behind the pectoral; body squarish, the four corners, two slightly angled mid-lateral lines, and the slightly angled mid-ventral line bearing sharp retrorse, serrate keels, so that each ring bears seven saws, independent from those of the next ring, with graduated teeth, increasing backward; the mid and latero-ventral keels cease at the vent, the mid-lateral slanting down to become latero-ventral on the tail; the latero-dorsal keels cease near the dorsal axil, their place on the tail being taken by a keel which arises over the mid-lateral a ring before the vent. Vent about half way between base of caudal and front of eye, rings 20 + 25. Dorsal on $2\frac{1}{2} + 5\frac{1}{2}$ rings, moderate in height, its base 1.3 in head, with about 43 rays. Caudal large, a little longer than head without snout; anal small, a little shorter than eye. Color in spirits olive, obscurely mottled lighter and darker, a dark stripe before the eye. Tail dusky with five white rings, somewhat irregular in size and placement. Dorsal colorless; caudal dusky.

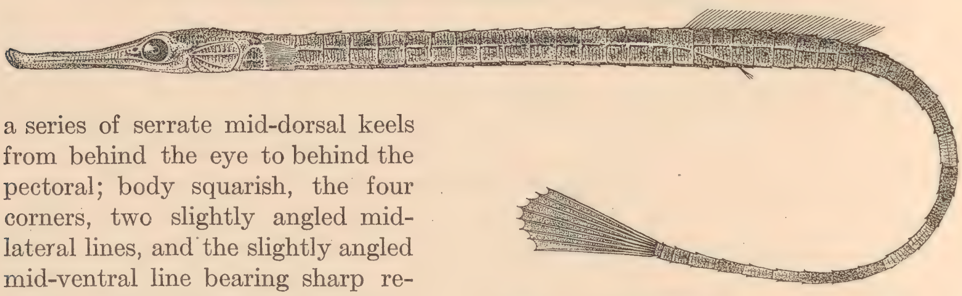

Fig. 1. *Doryrhamphus sierra* sp. nov.

Besides the type we have 13 similar specimens collected with it, No. 4841, American Museum of Natural History. When fresh, their color was blackish, tail with 4 or 5 white rings, caudal blackish, its lower margin white. The tail of one of the specimens was wasted and soft, and immediately broken. All, including the type, are apparently ♀ ♀ juv., there being no sign of the pouch which should be present in the ♂. The vent is nearer the gill opening than the base of the caudal in every case. The caudal fin of the type is evidently broken. In a specimen in which it is intact it is longer than the snout.

Doryrhamphus lineatus (Kaup) was described from Bahia, Mexico, and Guadaloupe, possibly based on several allied species. The nomenclature will be subject to revision until a large enough series of *Doryrhamphus* from the Eastern Atlantic has been studied to determine the part played by geographical and age variations. The present specimens and species are notable for extreme roughness, slenderness, and very long caudal fin. The writer cannot bring himself to consider them the young of *lineatus,* or the same species as a larger specimen so identified from Tabasco, Mexico, No. 5165, U. S. National Museum.

Myripristis jacobus *Cuvier & Valenciennes.*

Two specimens, doubtless from Condado Bay, were obtained from boys at Santurce, one collected July 21, the other at about that date.

Nomeus gronovii (*Gmelin*).

A small specimen captured under a *Physalia* which was drifting on the beach near the mouth of the Loiza River, July 25. As *Physalia* is common about the island, *Nomeus* is probably so also.

Bathystoma aurolineatum *Cuvier & Valenciennes.*

Three specimens of *Bathystoma* obtained at the Ponce market July 31, are referable to *aurolineatum,* not to *rimator* or *striatum,* the species previously recorded from Porto Rico.

Calamus pennatula *Guichenot.*

Three specimens of *Calamus* from Ponce market July 31, are referred to this species. They have been compared with specimens in the American Museum of Natural History which I identify as *bajonado* and *proridens,* and they do not agree with the description of the type of *kendalli.*

Xystæma havana *Nichols.*

Two specimens detected among Gerrids obtained from boys who said they were captured at Fort San Geronimo. It is difficult to differentiate this form from species of *Eucinostomus* without dissection.

Eupomacentrus atrocyaneus (*Poey*).

Among other fishes of this genus obtained from boys at Santurce July 20, doubtless caught in San Juan Bay, is one more slender specimen with different fin and body outlines, No. 4911, American Museum of Natural History, which is referred to *atrocyaneus* (Poey), erroneously synonymized with *fuscus* (Cuvier & Valenciennes).

Eupomacentrus chrysus *Bean.*

A single specimen was captured July 15 near shore in shallow water beside an old iron hulk not far from San Antonio bridge. It agrees well with the type description and figure of the species. In life it had the following colors: orange-yellow all over; back dorsal and anal edged with dusky which extended down the sides in narrow bars; large dark-blue oval on base of soft dorsal, extending onto back, edged with light-blue. Smaller, similar circular ocellus on peduncle; dark-blue spot at base of pectoral; iris dusky.

Abudefduf analagus (*Gill*).

A single specimen about 170 mm. in total length, from Condado Rocks, July 18, has been compared with the type of *analagus* in the United States National Museum, a fish of about the same size, of which it is almost the counterpart.

Thalassoma nitidum (*Günther*).

Small individuals were very common in tide pools and close to shore among the rocks in the vicinity of San Juan; several were obtained.

Thalassoma bifasciatum (*Bloch*).

A single specimen obtained at Santurce from boys, July 21.

Monacanthus tuckeri *Bean.*

A single small specimen about $1\frac{1}{2}$ in. long, dredged in Condado Bay, near the inlet, July 21, 1914. Color in life olive, paler below; large pale-blue reticulations on lower side anteriorly; pelvic flap with bright yellow margin; pectoral, dorsal and anal fins rose-colored; caudal with an inky black central spot, and pale bars along the upper and lower margins.

Callionymus calliurus *Eigenmann & Eigenmann.*

A single small specimen about one inch long dredged in Condado Bay July 21, is the first of this family to be recorded from Porto Rico.

Gobius translucens sp. nov.

The type and only specimen obtained, No. 4802, American Museum of Natural History, was taken in perhaps 12 feet of water close to the shore near the San Antonio Bridge, San Juan, July 15, 1914. It is 27 mm. long to base of caudal; head 3.3 in this measure; depth 4.4; eye 3 in head; snout 4; maxillary 2.6, extending to under front of pupil; lower jaw slightly projecting; interorbital space very narrow, concave; profile low, gently arched above, rather straight below; a row of small, rather wide-set conical teeth in jaws; gill openings wide; scales rather large, ctenoid, 23 in a longitudinal series; dorsal VI–10, anal 10; fins all moderate. Longest dorsal spine 1.4 in head, longest dorsal ray 2.; pectoral about equal to head. The caudal, which is broken, was evidently somewhat pointed, probably slightly shorter than head; united ventrals 1.3. In spirits straw color, the sides with two series of diffuse vertical brownish marks, the lower of these extending straight to the base of the caudal, the upper reaching the back near the axil of the soft dorsal and forming three or four saddle-like marks on the peduncle. Nine strong dark spots on the mid line of the back, the first just back of the eye, the last in the axil of the soft dorsal, in the front of the first above mentioned "saddle"; a strong dark stripe from the eye to the shoulder, a faint narrow, more or less parallel one above it, best marked posteriorly. A narrow, dark streak passes from the snout below the eye and backward, and a streak connects a dark bar at the end of the maxillary with a dark triangle on the opercle; two black spots connected by a black vertical bar on the base of the caudal; scales of the body with a tendency to dark margins and pale centers.

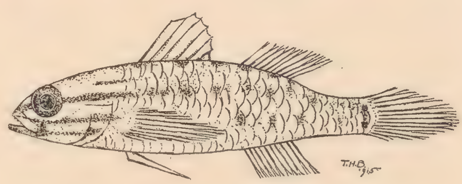

Fig. 2. *Gobius translucens* sp. nov.

This fish is close to *G. glaucofrænum* (Gill). The color pattern alone would differentiate it, however, unless there is more variation than supposed in the small gobies allied to this form.

Gobius boleosoma *Jordan & Gilbert.*

Common in shallows Condado Bay and vicinity. A number collected.

Blennius cristatus *Linné.*

A few obtained with *Salariichthys textilis,* Condado Rocks, July 14. Probably rather common.

Salariichthys textilis (*Quoy & Gaimard*).

Abundant in shallow sea-washed pools at Condado Rocks. A number obtained July 14.

59.9,7,32S(8)

Article VIII.— REVIEW OF THE SOUTH AMERICAN SCIURIDÆ.

By J. A. Allen.

Plates I–XIV, and 25 Text-Figures.

CONTENTS.

Introduction.

The present 'Review' is an attempt to summarize and correlate our present knowledge of the Tree Squirrels of South America. The material on which it is based, while far exceeding in amount that available to any previous investigator of the subject, is painfully insufficient for a satisfactory revision of the group, but the author hopes that the results here brought together will be an aid to future workers in this field.

The basis for this undertaking is primarily the large collection of South American squirrels in the American Museum of Natural History, the greater part of which has been obtained during the last four years by expeditions sent out by the Museum to northern South America, under the direction, and largely through the efforts, of Dr. Frank M. Chapman, Curator of Birds in the American Museum. The purpose of these expeditions, thus far carried on mainly and extensively in Colombia, Venezuela, and Ecuador, has been the accumulation of material for a detailed study of the bird and mammal faunas of South America, with reference not only to the determination of the forms occurring there, but as well to their genetic and geographic relationships. The present is the third contribution of a somewhat monographic character based on the mammals, the first being my revision of the murid genus *Melanomys,* published in 1913,[1] and the second my review of the genus *Microsciurus,*[2] published in 1914. It was my intention at first to follow the *Microsciurus* paper with similar reviews of other groups of the South American Sciuridæ, but as the work progressed it was found preferable to combine the results in a single paper, and to delay publication in order to utilize the collections in prospect from expeditions still in the field. In the meantime it seemed best to publish in advance the descriptions of new forms [3] discovered in the material at hand. In order to make the present paper a complete summary of the subject, the genus *Microsciurus* is here included, but the paper on this genus is given only in outline and brought down to date, the detailed descriptions and nomenclatural and other comment being omitted; and the same is true of the paper in which the various new forms were described.

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[1] Revision of the *Melanomys* Group of American Muridæ. Bull. Amer. Mus. Nat. Hist., Vol. XXXII, pp. 533–555, pl. lxviii, November 17, 1913.

[2] Review of the Genus *Microsciurus.* Bull. Amer. Mus. Nat. Hist., Vol. XXXIII, pp. 145–165, February 26, 1914.

[3] Descriptions of New South American Squirrels. Bull. Amer. Mus. Nat. Hist., Vol. XXXIII, pp. 585–597, October 8, 1914. One genus and 14 species and subspecies here described as new.

A word respecting the origin of the present paper seems pertinent. Owing to the scarcity of authentically determined South American mammal material in American museums, including especially type material, I took with me early in 1913 some 600 specimens of small mammals recently received from our collectors in Colombia and Ecuador for direct comparison with the historic material in the British Museum. No monographic work was then contemplated, only the identification of my own material. Although my time was limited, I was able to devote about three weeks to the study of the South American Sciuridæ, which enabled me to become fairly familiar with the extensive British Museum series of these animals, as I listed nearly all the specimens, with their localities and other data, including collectors' measurements when present. I also studied carefully such types as had direct bearing upon my own material, and intended to take in hand all of the sciurid types from South America, although I had not then decided to take up the group comprehensively, but lack of time prevented, greatly to my subsequent regret, for on returning to the American Museum I soon decided to take up the squirrel group collectively, on the basis of my British Museum notes and the material in American museums. This plan has worked out quite satisfactorily except in the case of a few of Gray's types, which I had failed to examine. To remedy this omission, and to reinvestigate a few doubtful points, I had fully arranged for another visit to London when the breaking out of the present European war rendered this plan impracticable, greatly to my disappointment and embarrassment. The present paper is therefore presented with some misgivings, but I trust the labor expended upon it will not prove wholly futile.

It is needless to say that the material I have examined is wholly inadequate for anything like a final revision of the subject. It has been enough to show how great are the deficiencies, which only time and future field work can supply. Even the Guianas and southeastern Venezuela are among the regions poorly represented in the present material, while from the vast area of Brazil there is only enough to afford an outline of the sciurid fauna. And the same is nearly true of Peru and Bolivia.

The present paper includes South America and Panama as far north as the Canal Zone, the forms of *Microsciurus* which occur north of this boundary, and the *Sciurus hoffmanni* group as represented in Chiriqui and Costa Rica, these being South American types. The extralimital forms comprise the following species and subspecies: *Microsciurus alfari alfari* Allen, *Microsciurus alfari browni* Bangs, *Microsciurus boquetensis* Nelson, *Mesosciurus hoffmanni hoffmanni* (Peters), *Mesosciurus hoffmanni chiriquensis* Bangs.

Acknowledgments.

The material studied in the present connection numbers not far from 1020 specimens, of which about 610 are in the American Museum, about 150 in the British Museum, 112 in the United States National Museum (including the collections of the Biological Survey), 42 in the Field Museum of Natural History of Chicago, 53 in the Cambridge Museum of Comparative Zoölogy, 24 in the Carnegie Museum of Pittsburgh, and 17 in the museum of the Academy of Natural Sciences of Philadelphia. To the authorities of these several institutions I am indebted for prompt and most cordial responses to my requests for assistance, they having freely loaned types as well as other material. Especially and most emphatically am I indebted to Oldfield Thomas, of the British Museum, for not only free access to the material in his charge, but for information, given verbally and through correspondence; to Gerrit S. Miller, Jr., of the U. S. National Museum, E. W. Nelson and E. A. Goldman, of the Biological Survey, W. H. Osgood of the Field Museum, Mr. Samuel Henshaw and Dr. G. M. Allen of the Museum of Comparative Zoölogy, and Dr. Witmer Stone of the Philadelphia Academy of Natural Sciences.

Mention should also be here made of the field explorers who have made accessible for study the large amount of pertinent material in the American Museum. First among these is Leo E. Miller, who for the last four years has been continuously in the employ of the Museum as a field assistant in South America — in western Colombia, Venezuela, British Guiana, and in Brazil and Paraguay with the Roosevelt Expedition, who has collected more than half of the South American squirrels now in the American Museum. William B. Richardson, in Ecuador and extreme southwestern Colombia, and G. M. O'Connell in the Bogotá district, have also gathered a large amount of valuable material. In earlier days important collections were made for the Museum in Peru by H. H. Keays, in the Santa Marta district of Colombia by H. H. Smith, and in various parts of Venezuela by S. M. Klages and M. A. Carriker, Jr. Of borrowed material mention may be made of the important material collected by E. A. Goldman in Panama (Biological Survey collection), by W. H. Osgood in Venezuela and Peru (Field Museum), by J. Steinbach in Bolivia (Pittsburgh Museum), by H. H. Smith in Matto Grosso (Philadelphia Academy collection); P. O. Simons in Ecuador, Peru and Bolivia (British Museum), and by Fraser, Bridges, Garlepp, Stolzmann, Palmer, Pratt, Fleming, and others in western South America, and Alphonse Robert, McConnell, and others in Guiana and eastern Brazil (British Museum).

Finally I cannot close these acknowledgments without expressing my sincerest appreciation of the cordial and sympathetic assistance rendered me by H. E. Anthony, assistant in Mammalogy, in relieving me of much of the drudgery necessarily attending an investigation of this nature, and for many suggestions by which I have greatly profited. The photographs used in the present connection have been made by the American Museum photographer, Julius Kirschner, under Mr. Anthony's supervision.

Explanation of Measurements.

All measurements are in millimeters, unless otherwise stated.

All external measurements are the collector's measurements from the specimen before skinning, unless otherwise stated.

Hind foot: *c* affixed to measurement in the tables of measurements = cum ungues, or foot to end of claws; *s* affixed = sine ungues, or foot to base of claws. The length of the hind foot as given in the text includes the claws unless otherwise stated.

Skull, total length = occipitonasal length; zygomatic breadth = greatest breadth at zygomata; interorbital breadth = least breadth of frontals; breadth of braincase = at squamoso-parietal suture; length of nasals = greatest length in straight line; breadth of nasals = greatest breadth at anterior end; maxillary toothrow = length at crown surface.

Measurements by different collectors cannot be taken as strictly comparable owing to the liability of difference in methods of measuring, except the total length, which should be in all cases comparable. When the collector gives only two measurements, as length of head and body and length of tail vertebræ, the total length here given is the sum of these two measurements; when the collector gives as measurements only total length and length of tail vertebræ, the head and body length is determined by subtracting the latter from the former. Obvious errors in collectors' measurements, due apparently to mistakes in recording them on labels, are sometimes corrected if the skins are well made and seem trustworthy for size and proportions; otherwise obviously erroneous measurements are wholly discarded. Only measurements of adult specimens, whether external or cranial, are utilized unless the fact of obvious immaturity is stated.

Measurements of specimens from different localities, when given collectively, are indicated as such in the accompanying text.

The measurements given in the general text are also separately tabulated for more convenient reference.

Historical Outline.

Species and subspecies.

The first species of squirrel from South America to receive a systematic name was *Sciurus æstuans,* named, but only very briefly described, by Linné in 1766, from Surinam, and renamed in 1801 by Shaw *Myoxus guerlingus.* The second species to receive a systematic name was *Sciurus* *pusillus* Desmarest, 1817, based on *Le petit Guerlinguet* of Buffon, from Cayenne. No other species was described till 1832, when Is. Geoffroy described and figured *Sciurus variabilis,* based on specimens supposed to have come from northern Colombia. The name has since been applied indiscriminately by authors to the large white-bellied red-backed squirrels of South America of which there are several species, some of which have no close interrelationship. As the description and figure are contradictory, and neither agrees well with any squirrel at present known, the name is here treated as unidentifiable.

In 1853 Brandt described *Sciurus langsdorffii,* from "Brasilia" — the first of various forms of the large bushy-tailed squirrels peculiar to the great Amazonian drainage basin to be made known, and the fourth recognizable species of South American squirrel described up to this date. In 1842 Wagner described *Sciurus igniventris* and *S. pyrrhonotus,* respectively from the Upper Rio Negro and the mouth of the Rio Madeira, both belonging to the *langsdorffii* group, which latter name (in 1850) he restricted to the form from Cuyubá, Matto Grosso. In 1843 he added *Sciurus gilvigularis,* from near the mouth of the Rio Madeira — a small species resembling *S. æstuans* in size and in coloration, to which it was generally erroneously referred for the next fifty years. Wagner's three species were all based on Natterer's collections.

In 1844 *Sciurus stramineus* was described and figured by Eydoux and Souleyet, a large squirrel from southwestern Ecuador. About the same time Poeppig (in Tschudi's 'Fauna Peruana') described *Sciurus tricolor,* the largest of all the South American squirrels. In 1845 Pucheran described two small squirrels from Santa Fé de Bogotá, Colombia, as, respectively, *Sciurus rufoniger* and *Sciurus chrysuros,* the relationships of which have only recently been determined, the names, when used, having been usually grossly misapplied. Only one other species was described for the next ten years, namely, *Sciurus nebouxi* I. Geoffroy, from northwestern Peru, a form closely related to *S. stramineus,* to which it is now referred as a subspecies.

This brings the number of species of South American squirrels described prior to 1856 to 13, representing 11 valid forms, one being unidentifiable and another a synonym. No more were added till 1867, when J. E. Gray published his 'Synopsis of American Squirrels' (Ann. and Mag. Nat. Hist. (3), XX, pp. 415–434, Dec. 1867). In this paper he described 18 species as new, of which 9 were from South America and 9 from Mexico and Central America. Of those described from north of the Isthmus of Panama only 3 are now regarded as valid forms, the others being synonymized with previously described species. Of the 9 South American species 4 are given recognition as species or subspecies in the present paper, 4 are assigned to synonymy and 1 is considered indeterminable. Gray's 'Synopsis' made endless trouble for his successors, the descriptions being in most cases inadequate for the satisfactory identification of the species, and often the localities given are too indefinite for the requirements of modern zoölogy. The types of the new forms are fortunately still in the British Museum, and through these his species have been for the most part satisfactorily allocated.

Doubtless Gray's bad work helped to bring about the radical reaction on the species question, which reached its climax about ten or twelve years later, when, in 1877, the present writer published a revision of the American Sciuridæ in Coues and Allen's 'Monographs of North American Rodentia,[1] in which all then known American Sciuridæ were included. Only 5 species were given positively as South American and one other (*Sciurus nebouxi* Eyd. & Sol.) provisionally. The number of South American specimens available for study numbered only 35, of which 15 were skins and 20 in alcohol. All of this material is again before me. The 20 alcoholic specimens and 7 of the skins were referred to *Sciurus æstuans,* but none of them is referable to *æstuans* as now restricted. Three other skins were referred to the Mexican *S. hypopyrrhus* Wagner, but they really represent *S. stramineus,* and one other skin referred to *S. variabilis* is referable to *S. igniventris.* The four skins referred to *S. gerrardi* represent *S. gerrardi choco* Goldman of the present review.

From the above statement it is evident that this 1877 revision of the South American Sciuridæ was based almost wholly on the literature of the subject, which was very fully cited, and discussed with considerable confidence, on the basis of what seemed to be the conditions of variation in Central American and North American species, which for that early period were fairly well represented in the material available.

The following year appeared Edward R. Alston's paper 'On the Squirrels of the Neotropical Region' (Proc. Zool. Soc. London, June, 1898, pp. 656–670, pl. lxi), based on the collections in the museums of London, Paris, and Berlin. He says: "Within the last year I have been able to examine in the British Museum and the Museums of Berlin and Paris, the types of no less than *forty-one* nominal species of Neotropical *Sciuri.* In these collections I have been able to compare much more extensive series of specimens than even Mr. Allen had access to; and, through his kindness, I have examined typical examples of the species recognized by him. This study has led me to accept many of Mr. Allen's identifications (some of which were sufficiently

[1] Monographs of North American Rodentia. Memoirs U. S. Geological and Geographical Survey of the Territories (Hayden), Vol. IV, August, 1877. Sciuridæ, pp. 631–949. Species inhabiting Mexico, Central and South America, pp. 738–779.

startling at first sight), and in some instances to carry the reduction of species still further; but it has also enabled me to correct a few errors in his synonymy, and to point out a few apparently valid species with which he was not acquainted.

"Particularly rich in this group are the Paris and British Museums; and the study of their long suites of specimens leads one irresistibly to conclusions which must appear strange to those who only know the extreme links of the chain. Among other things they have convinced me that Mr. Allen has laid too much stress on the comparative size of the ears, and length and bushiness of the tail, as distinctive characters. In both these points, as well as in the quality of the pelage, every intermediate stage is often to be found; and I have therefore been obliged to unite Mr. Allen's *S. aureogaster* and *S. leucops*, his *S. boothiæ* and *S. hypopyrrhus*, and his *S. gerrardi* and *S. variabilis.* On the other hand, I have felt obliged to recognize, at least provisionally, the specific rank of *S. stramineus*, *S. griseogenys*, *S. rufo-niger*, and *S. pusillus* and more doubtfully that of *S. griseoflavus*,— thus raising the number of species from ten to twelve" (*l. c.*, pp. 657, 658).

The seven species recognized by Alston as occurring in South America are *Sciurus stramineus*, *S. variabilis*, *S. griseogenys*, *S. æstuans*, *S. deppei*, *S. rufo-niger*, and *S. pusillus*, the first and the last being additional to those recognized by me the previous year.

A few months later I published my 'Synonymatic List of the American Sciuri, or Arboreal Squirrels' (Bull. U. S. Geogr. and Geol. Survey Terr. [Hayden], IV, pp. 877–887, and p. 905, footnote), in which I accepted the two species added by Alston, who in the meantime had kindly sent me specimens of *S. pusillus* for examination. In this list all the forms recognized by Alston are accepted, but the names adopted by him for two species are shown to be untenable.

This was for a long time the 'last word' on neotropical squirrels. Jentink, five years later, in his 'List of the Specimens of Squirrels in the Leiden Museum',[1] adopted the conclusions above outlined, except that he evidently did not know of my 'Synoptic List,' and in several instances reverted to the nomenclature of my 'Monograph' instead of accepting Alston's revision of it. He also thought Alston had admitted too many species and erroneously reduced three of them to synonyms, recognizing only 5 neotropical species in the collection of the Leyden Museum, represented apparently by 98 mounted skins and 20 skulls.

It was nearly twenty years before any naturalist again described a new species of squirrel from South America, the tendency being for a time to

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[1] Notes from the Leyden Museum, V, 1883, pp. 91–144; American Squirrels, pp. 91–115.

reduce even the number admitted by Alston and Allen in 1878! The first to be added was *Microsciurus peruanus* Allen in 1897, followed in 1898 by *M. mimulus* Thomas, *Sciurus pyrrhinus* Thomas, and *Sciurus saltuensis* Bangs. In the following years new species and subspecies were frequently added, chiefly by Thomas and the present writer.

The total number of specific and subspecific names based on South American species of squirrels prior to the close of the year 1914 is 88, of which only one was published prior to the year 1800, and 12 prior to 1850; 15 appeared between 1850 and the end of the year 1898, of which 11 (10 of them by Gray) date from 1867. Only one new species was described between 1872 and 1896, but 4 were added in 1897 and 1898. In 1899 were added 8, and in 1899 to 1914 (both inclusive) 55, of which 20 were described in the single year 1914.

Of the total number of 88 names given to South American squirrels prior to 1915, 18 prove to be synonyms or indeterminable, while 3 were given to replace preoccupied names.

Comparison of the resources and viewpoints of 1878 and 1898.

Prior to about 1865 mammals of any species were usually represented in museums by only a few specimens, and never by large series from a single locality. The range of seasonal, geographical, and individual variation was hence necessarily little known. Soon after this date material began to accumulate rapidly in this country, so that it became possible to study successfully each of these questions. It was found that the range of individual variation in the commoner species, which could easily be collected in large series, was far greater than was commonly recognized; that season and locality had a great influence upon the character of the pelage; and that different geographical areas usually presented certain distinctive features of variation, notably in size and coloration, in correlation with the extent and character of divergent conditions of environment; and that the transition between local or geographic forms was as gradual and as complete as the correlated transition in physical conditions. All this was real progress in knowledge. It was found in some instances that the alleged characters of forms currently recognized as species were less divergent than the extremes in a large series of individuals of the same species from a single locality; and that in many other instances supposed species from somewhat distant localities completely intergraded in the intervening areas, and that it was more logical to treat such forms as 'varieties' than as full 'species.' This view soon met with wide acceptance in America and proved to be the stepping-stone to the present system of trinomial designations for intergrading forms. This change of view at first made headway slowly abroad, but in the course of a few decades came to be almost universally accepted, finally taking form as a principle of nomenclature in all modern zoölogical codes.

But these discoveries were, for a time, not unmixed with evil in their results, especially with respect to mammals, where so many points have to be considered, and where in general, until near the close of the nineteenth century, the amount of material from outside of the temperate portions of North America was very small and very defective in quality. In the case of the smaller, and especially the exotic, species, as late as 1877, the skulls were often left in the skins, there were rarely any trustworthy measurements, dates of collecting were often omitted, and the localities given were usually more or less indefinite. Mexico, Central America, New Granada, Brazil, South America, written on the label, gave no very definite clew to the actual locality and environment of the specimen. Such was the state of affairs when, at the height of the lumping craze in 1877, I ventured to publish my 'Monograph of the American Sciuridæ.' A system that worked well where material was fairly adequate proved, as already shown, woefully inadequate when applied to little known faunal areas, like the American tropics.

The viewpoint of 1878 is well indicated in the following extracts from the introduction to Mr. Alston's paper 'On the Squirrels of the Neotropical Region.' He says: "No better example of a polymorphic genus can be found than the almost cosmopolitan *Sciurus*. Even our common European Squirrel assumes such phases of coloration in the north, in the east, and among the Alps that the extremes would undoubtedly be considered perfectly distinct species if the intermediate links were not known.... [1]

"In facing the intricate and often baffling problem of distinguishing between 'species' and 'varieties' in such a protean group, I have endeavored to act in harmony with Mr. Darwin's directions: 'When a naturalist can unite by means of intermediate links any two forms, he treats the one as a variety of the other.' It must be remembered that many of these 'varieties' apparently breed true and prevail in certain parts of the range; but all that are here brought together are united by such intergradations that a sufficient series at once convinces one of their identity. It is evident, however, that still more complete material will be required before every point can be regarded as definitely settled."—Proc. Zool. Soc. London, 1878, pp. 656, 658.

The viewpoint of twenty years later (1898) may be illustrated by Mr. E. W. Nelson's 'Revision of the Squirrels of Mexico and Central America,'

[1] In 1912 Mr. Gerrit S. Miller, Jr., in his 'Mammals of Western Europe' (pp. 898–923) found it desirable to recognize 12 subspecies of the European Squirrel from western and central Europe.

published in May, 1899 (Proc. Washington Acad. Sci., I, pp. 15–110, pll. i and ii), based on 795 specimens.[1]

From a study of this material Mr. Nelson recognized 41 forms (excluding 3 from north of Mexico),— 28 species and 13 subspecies, of which 6 were described as new, in contrast with my 9 in 1877, and Alston's 7 in 1898. According to Mr. Nelson's synonymies, my 9 Mexican forms included 13 of his, 28[2] of his 41 forms being based on new material not available in 1877.

But the quality of the material at these two periods was as different as was the amount. In contrast with the roughly prepared and frequently distorted, half-filled skins, giving little clue to the size, proportions, or external appearance of the animal, and without measurements taken from the specimen while in the flesh, or definite data as to sex, locality, and date of capture, and the skulls often unavailable for examination, of the earlier period, the bulk of the new material consisted of smoothly-made skins, giving the correct proportions of the animal, each with its well prepared skull, accompanied by labels giving the fullest field data, and the external measurements made before skinning. In Mr. Nelson's case he had the further immense advantage of an intimate personal knowledge of the geographic conditions of the greater part of the area to which his revision of the squirrels related.

The excessive 'lumping' of the earlier period, in respect to mammals, was due in large part to the limited amount and the poor quality of the material available for study, and in part to the mistaken assumption that it was adequate for permanent revisionary work; also to the belief, of at least some of the prominent investigators of that day, that the mammal fauna of North America, and of some other parts of the world, was already pretty well known. Indeed, the announcement of the discovery of new forms, in certain groups at least, was looked upon with suspicion. Yet the prosecution of extensive field work under new methods of collecting and of preparation disclosed new genera as well as new species in supposedly previously well-worked fields.[3] With this increase of material and the improvement in its quality has come the possibility, as well as the inclination, to recognize finer distinctions than formerly, so that many forms given nomenclatural status at present would not have been thus honored had these

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[1] This may be contrasted with my total of 79 specimens for the same region, which included three of *Sciurus arizonensis* (the only ones then known), referred to *S. colliæi* of Mexico. Alston must have had access to much more extensive material, as well as to the types of most of the previously described species.

[2] Of these 4 were described by me between 1889 and 1895 — *S. nayaritensis* (1889), *cervicalis* (1890), *apache* (1893), *alfari* (1895).

[3] Miller in 1912, in his 'List of North American Land Mammals' (Bull. 79, U. S. Nat. Mus.), listed 2138 forms (species and subspecies), as against 363 given by True in 1885, and 1405 given by Miller and Rehn in 1900.

fine differences been recognized, as indeed many of them were, and ignored. The 'splitting' craze of to-day may not be so harmful to scientific progress as was the 'lumping' craze of thirty years ago, but it is certainly burdening nomenclature to an embarrassing and unprofitable degree. As the field of discovery in the matter of noteworthy new forms is becoming exhausted, as in North America, intergrades between already recognized slightly differentiated forms are given names and appear in faunal lists, to the confusion of even the expert unless he be provided with plenty of topotype material. While faunistic studies cannot be made too intensive, minor local differentiations do not require pigeon-holing by means of nomenclature; they can be otherwise recorded as interesting facts in environmental differentiation.

General Considerations.

Before taking up the subject of genera and subgenera in relation to the American forms of tree squirrels heretofore usually referred to the genus *Sciurus*, it seems desirable to present certain general facts that have a bearing on genetic relationships, and also to discuss some other generalities that may be better considered here than elsewhere.

Premolar formula.

In the Sciurinæ the presence or absence of p^3 is usually looked upon as of small taxonomic importance, since in some groups it is absent or reduced almost to disappearance, although in other groups it not only reaches the crown level of the molars but is sometimes an obviously functional tooth. Formerly it was sometimes looked upon as a feature of the milk dentition, which might or might not reappear in the permanent dentition, and therefore in some cases was evanescent. On the contrary, as stated by Nelson in 1899 (*l. c.*, p. 49): "It is not present with the milk premolar in immature skulls, but appears coincidently with the permanent premolar and is equally persistent." Geographically considered, it is absent in all species of South American squirrels except the peculiar and highly specialized genus *Microsciurus* of the Andean highlands of western South America, which occurs also as an intrusive genus in Central America as far north as central Costa Rica, and in the still more specialized genus *Sciurillus* of the Guianas. It is present in all species of North American squirrels except in *Parasciurus* (*Parasciurus* + *Aræosciurus*) of eastern United States and the Mexican tableland, and the intrusive *Mesosciurus* (= *Guerlinguetus*, part, auct.), of

South America, which ranges north in Central America as far as northern Nicaragua. These facts seem to imply genetic significance in the presence or absence of p^3.

The degree of development of p^3 varies in different super-specific groups. In *Tamiasciurus* it is reduced to a minimum and is often absent. In this group it is truly vestigial, being always very small, barely or not always piercing the gum, and nearly hidden beneath the crown of p^4. Yet its geographic constancy is noteworthy, it being present in about equal development in all three species of the group, and in all of their numerous subspecies, which collectively occupy all the wooded portions of North America from northern Georgia and the mountains of northern Lower California north to the limit of trees. In *Neosciurus* and *Echinosciurus* it is generally small and slender, but usually reaches the crown level of p^4. In *Hesperosciurus, Otosciurus,* and in the tropical *Microsciurus* and *Syntheosciurus,* it is a conspicuous and functional tooth, frequently with a bicuspid crown. Its presence and degree of development, or absence, usually accompany marked specialization in other features.

Mammæ.

Text Figures 13–16, p. 165.

All American tree squirrels have either 6 or 8 (either 3 or 4 pairs) of mammæ, those with 6 having one of the abdominal pairs absent. All North American species have 8 mammæ, except *Baiosciurus* of eastern and southern Mexico, Guatemala and Nicaragua, and the intrusive South American *Mesosciurus.* All the squirrels of the northern border of northern South America (north of the llanos of Venezuela) and of the Andean region south to Peru and Bolivia, have only 6 mammæ, while all other South American squirrels have 8 mammæ, including not only the giant squirrels of the Amazonian drainage but also the little guerlinguets of the Guianas and eastern Brazil. Furthermore, the South American species with 8 mammæ are widely separated geographically from the North American species with 8 mammæ. The species with 6 mammæ include also species of large size as well as the smallest American forms. Thus the number of mammæ is not fortuitous but a factor of great constancy, as it is also one of high physiological significance. It doubtless has considerable taxonomic value, since supernumerary mammæ are about as rare as supernumerary teeth.

Size as a group character.

Text Figures 1–12, pp. 162–164.

South American squirrels present quite a range of difference in size, but the members of a closely related group of species agree so nearly in both size and proportions that often neither can be relied upon as diagnostic features, the range of individual variation in a dozen specimens of the same species, or subspecies, as the case may be, exceeding the average difference between allied forms. *Mesosciurus*[1] contains two subgenera, each of which comprises 12 forms. The two groups are not closely allied, either in size or coloration. The difference in average total length in the 12 forms of the first group is less than 20 mm., while the range in individual variation in total length ranges from 30 to 50 mm., or more, in each form. In the same group the average total length of the skull ranges from 54.5 to 57 mm. (a range of only 2.5 mm.), while the range of individual variation in each form runs from 3 to 4 mm. Taking the skull, which is the more trustworthy basis, and excluding three subspecies that are decidedly above the average, the average total length varies in the remaining 10 forms from 49 to 52 mm., a range of 3 mm., while the individual range in each form runs from 2 to 4 mm. The same comparison could be carried through other groups with similar results. The point is, first, that closely related forms present a small average range of variation in size, *inter se,* and a very wide range of individual variation; second, that measurements, external or cranial, have little diagnostic value.

The American squirrels fall into a number of superspecific groups in which difference in the size of the animal is a marked feature. The smallest are the pygmy squirrels (*Sciurillus* and *Microsciurus*) of the Guianas and Andean regions respectively, with a total length of about 225 to 260 mm., and the size increases by steps or stages to the giant squirrels of the Amazonas with an average length of about 575 mm., with individuals exceeding 600 mm. The size of the skull varies, *pari passu,* from less than 30 to more than 60 mm., the giant squirrels being cubically about eight times larger than the pygmy squirrels. The feature of size is always correlated with other differences, and should seemingly carry weight as a diagnostic character. It is presented graphically in accompanying illustrations.

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[1] For diagnosis see *postea,* p. 182.

Explanation of Text Figures 1–12.

All figures one fourth nat. size.

Figures 1–12 are to show relative size, and the relative length of the tail to the total length. Figures 13–16 are to show the number and position of the mammæ.

Fig. 1. *Microsciurus similis similis* (Nelson). No. 32497, Am. Mus., ♂ ad., Gallera, Western Andes, Colombia.

Fig. 2. *Leptosciurus pucheranii pucheranii* (Fitzinger). No. 34621, Am. Mus., ♂ ad., Fusugasugá, Eastern Andes, Colombia.

Fig. 3. *Leptosciurus ignitus ignitus* (Gray). No. 16560, Am. Mus., ♀ ad., Inca Mines, Peru.

Fig. 4. *Notosciurus rhoadsi* Allen. *Type.* No. 12725, Mus. Acad. Nat. Sci. Philadelphia. ♂ juv., Paguma Forest, Chunchi, Ecuador. (See also Fig. 17.)

Fig. 5. *Mesosciurus hoffmanni hoffmanni* (Peters). No. 18089, Am. Mus., ♂ ad., Mount Irazú, Costa Rica.

Fig. 6. *Mesosciurus gerrardi versicolor* (Thomas). No. 34166, Am. Mus., ♂ ad., Barbacoas, Colombia.

Fig. 7. *Guerlinguetus æstuans æstuans* (Linné). No. 36492, Am. Mus., ♂ ad., Bonasica, Essequibo River, British Guiana.

Fig. 8. *Guerlinguetus ingrami* (Thomas). No. 36487, Am. Mus., ♂ ad., Alambary, São Paulo, Brazil.

Fig. 9. *Hadrosciurus flammifer* (Thomas). No. 16946, Am. Mus., ♂ ad., Suapure, Venezuela.

Fig. 10. *Urosciurus tricolor* (Pœppig). No. 19762, Field Museum, ♂ ad., Yurimaguas, Peru.

Fig. 11. *Urosciurus duida* (Allen). *Type.* No. 36153, Am. Mus., ♀ ad., Rio Cunucunumá, base of Mt. Duida, Venezuela.

Fig. 12. *Simosciurus stramineus stramineus* (Eydoux and Souleyet). No. 9014, U. S. Nat. Mus., ♂ ad., Guayaquil, Ecuador.

Fig. 13. *Leptosciurus ignitus irroratus* (Gray). Same specimen as Fig. 3.

Fig. 14. *Mesosciurus gerrardi morulus* (Bangs). No. 170991, U. S. Nat. Mus., ♀ ad., Rio Indio, Canal Zone, Panama.

Fig. 15. *Guerlinguetus æstuans quelchii* (Thomas). No. 20036, Field Museum, ♀ ad., Serra da Lua (near Boa Vista), Brazil.

Fig. 16. *Urosciurus tricolor* (Pœppig). Same specimen as figure 10.

Ratio of tail length to the total length.

Text Figures 1–12, pp. 162–164.

The length of the tail vertebræ, relative to the total length of the animal, varies greatly in different groups of tree squirrels, probably in relation to their habits, being developed in proportion to their exclusiveness as tree dwellers. The North American chickarees (*Tamiasciurus*) and the Andean pygmy squirrels have the shortest tails of all the American species. Little

Fig. 1. *Microsciurus similis similis.*
" 2. *Leptosciurus pucheranii pucheranii.*
" 3. *Leptosciurus ignitus ignitus.*
" 4. *Notosciurus rhoadsi.*
" 5. *Mesosciurus hoffmanni hoffmanni.*
One fourth nat. size. See p. 161 for description.

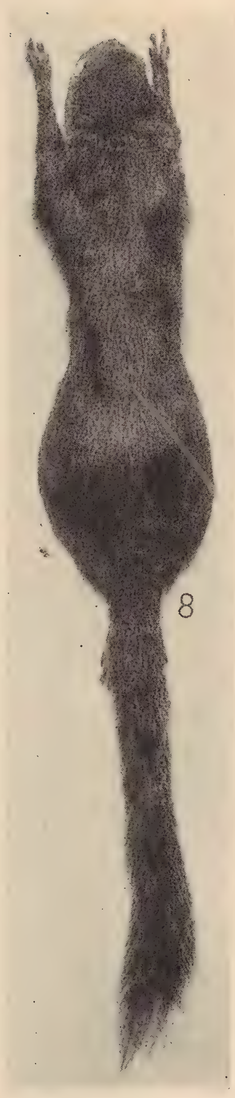

Fig. 6. *Mesosciurus gerrardi versicolor.*
" 7. *Guerlinguetus æstuans æstuans.*
" 8. *Guerlinguetus ingrami.*
" 9. *Hadrosciurus flammifer.*
One fourth nat. size. See p. 161 for description.

Fig. 10. *Urosciurus tricolor.*
" 11. *Urosciurus diuda.*
" 12. *Simosciurus stramineus stramineus.*
One fourth nat. size. See p. 161 for description.

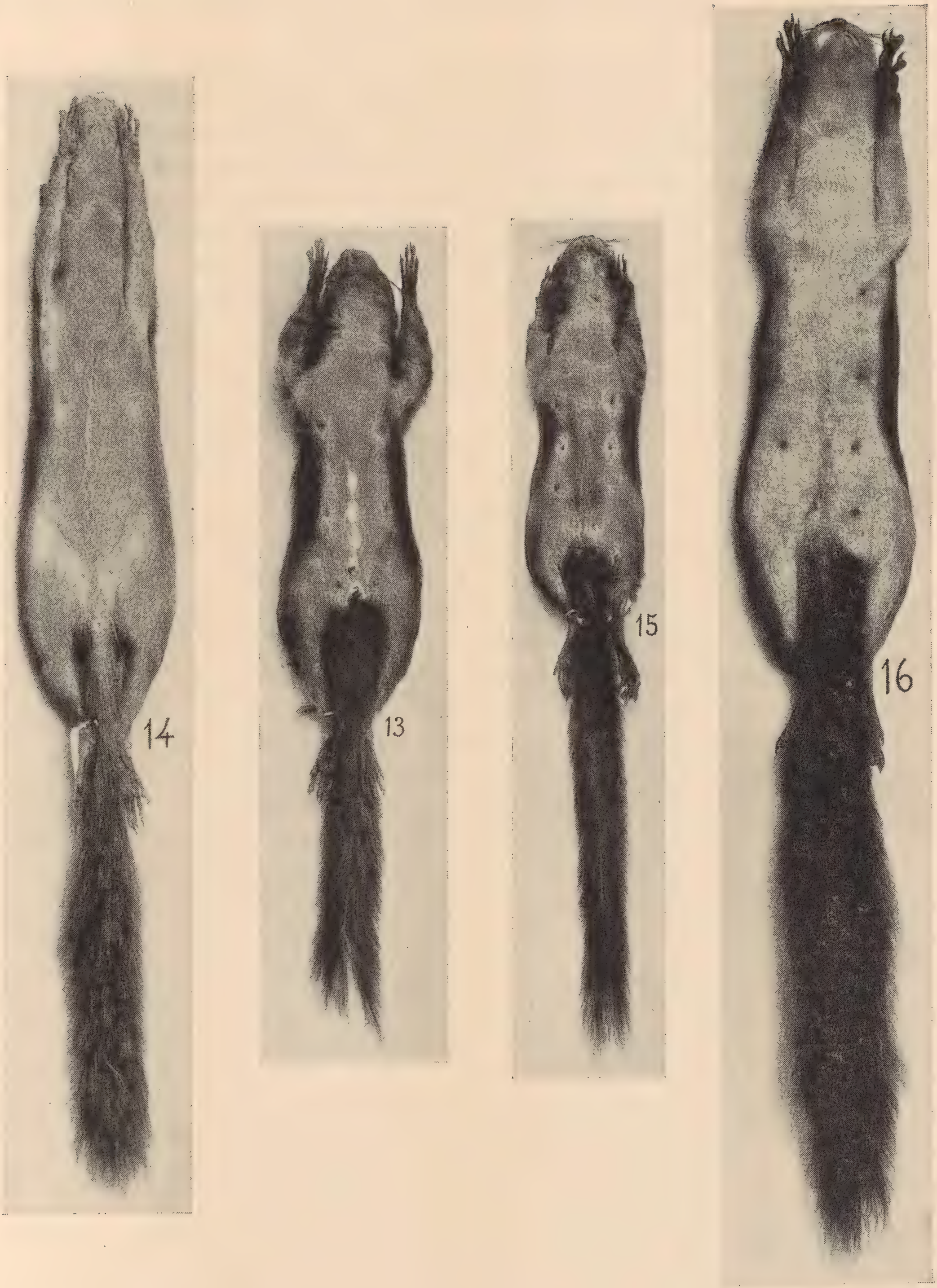

Fig. 13. *Leptosciurus ignitus ignitus.*
" 14. *Mesosciurus gerrardi morulus.*
" 15. *Guerlinguetus æstuans quelchii.*
" 16. *Urosciurus tricolor.*
One fourth nat. size. See p. 162 for description.

is known of the habits of the latter, but the chickarees are well known to be less arboreal than the larger and longer tailed squirrels. The ratio of tail length to the total length varies in different groups from about 40 to 52%, and is very constant in groups of squirrels that are nearly related. It is not, however, closely correlated with the size of the animal, although all large squirrels are long-tailed, but so also are the Guiana pygmy squirrels and the guerlinguets of eastern Brazil and the Guianas. It therefore seems proper to give weight to the relative length of the tail as a taxonomic character.

Value of averages and ratios in diagnosis.

In view of what has just been said respecting the wide range of individual variation, it is evident that ratios between different parts, as the length of the tail to the total length, and of parts of the skull to each other or to the skull as a whole, are of slight value if based on single specimens, they being necessarily as variable as the measurements on which they are based. On the other hand, ratios based on averages may have a high value as a convenient formula in diagnosis, and as bases of comparison of allied forms. But the number of specimens on which such ratios are based should be large enough to approach closely the normal for the form in question — at least 10, and preferably more, selected to include only suitable specimens, *i. e.*, excluding adolescent and senile individuals. In the case of the skull, ossification continues after the period of sexual maturity is reached, and in old age there is often an excessive deposit of bony matter at peripheral points much beyond normal adult conditions. It is not usual, however, to find at hand sufficient material of a given form to furnish a satisfactory basis for ratios, and one must make discretionary use of whatever may be at hand. Three or four specimens afford of course more trustworthy results than a single specimen, however normal it may seem to be. Ratios based on single specimens, or on specimens that have not reached middle-life, are not to be trusted, as they may be very misleading. Nor can trustworthy ratios be obtained from photographs, as ordinarily taken. In the case of squirrel skulls, for instance, the depressed parts, as the rostrum and occipital region, become so much foreshortened in the photograph that ratios based on the flat surface of the photograph will sometimes vary 10 to 20% from the same ratios based on the skull from which the photograph was taken! This was to me a surprising result, learned only after considerable work had been expended in computing ratios from the flat surface of photographs.

Another point to be mentioned in connection with averages and ratios, brought out strongly in computing skull ratios, is the difficulty of taking correct measurements of convex surfaces, or where the boundaries of parts are not sharply defined, as with the posterior border of the nasals in mammals. In the work here presented all measurements were taken with dividers in a straight line between the most extreme points of the parts measured. In the case of the nasal bones in squirrels, it is difficult to measure the same specimen twice alike; and the difference of half a millimeter in the length of the nasals will very essentially affect the result in computing, *e. g.*, the ratio of the length of the nasals to the interorbital breadth. In such cases there is, further, the element of the personal equation whenever the work of two or more investigators is subjected to comparison. In the case of averages, such slight aberrations are likely to offset each other, and hence the only trustworthy ratios are those based on a normal determined from averages.

Pelage and coloration.

Squirrels which live in temperate and boreal zones have always soft, thick fur, with abundant underfur, the thickness of the coat being correlated with climatic conditions; the coat is hence longer and thicker in winter than in summer. A similar correlation would be expected in squirrels inhabiting tropical and subtropical zones. It not only prevails similarly under tropical conditions, but here environment over-rides genetic relationship. In tropical lowlands the pelage is shorter and thinner, usually without underfur, and often more or less coarse and hispid, in contrast with that of species of the same genus, or even with that of subspecies of the same species, living at altitudes of 6000 to 12,000 feet in nearby mountain ranges. This is true not only of the pygmy squirrels of the genus *Microsciurus*, but of various members of *Echinosciurus* (as mentioned repeatedly by Nelson (*l. c.*, p. 21 and *passim*) of Mexico and Central America, and in *Microsciurus*, *Mesosciurus*, and *Guerlinguetus* in South America. The character of the pelage has therefore little taxonomic significance except among conspecific subspecies.

The case is quite different in the matter of coloration, which, as has often been observed, is frequently a trustworthy index of genetic relationship. The *Tamiasciurus* group of North America has a distinctive style common to the group as a whole, but it is not so strongly marked as in the ground squirrels of the genera *Tamias* and *Eutamias*. What would be called a distinct 'pattern' of coloration is absent in most tree squirrels, where, in some groups, individual variation in color runs riot, as is exceptionally exemplified in the *Echinosciurus* group of Mexico and Central America. On the other hand, certain groups, as *Microsciurus*, *Guerlinguetus*, *Urosciurus*, and a numerous group of species and subspecies in *Meso-*

sciurus, have each a fairly constant or uniform style of coloration, while in another group of the last-named genus it varies not only with each subspecies, but in some of the subspecies the range of individual variation is so excessive that it is difficult to find two specimens from the same locality that are wholly alike, with extremes that are exceedingly diverse. Variability in coloration is as much a feature of this group as constancy to a single type of coloration is a feature of certain other groups. In general, South American squirrels, large or small, have red bellies, or underparts that are washed or suffused with buff, ochraceous, or deep ferruginous; a few only have pure white bellies. There is a tendency to a black dorsal area in many species of the Andean region — restricted and not strongly developed in some of the forms of *Leptosciurus* and *Microsciurus,* but strongly developed in some of the subspecies of the *hoffmanni* group, and in all of the subspecies of the *Mesosciurus gerardi* group, in some of which the median half or more of the dorsal area is deep black, with the limbs and flanks red. In most of the smaller species of South America the upperparts are gray, suffused more or less strongly with fulvous or rufous; in the larger species, brown strongly washed or suffused with ferruginous.

Melanism, in the usual sense, is rare in South American squirrels, the only known instance being *Sciurus flammifer* Thomas of the Orinoco Valley, in which about half of the known specimens are strongly melanistic. A few melanistic specimens of other species have been recorded, being noteworthy on account of the rarity of such occurrences in South America. On the other hand, melanism is a widespread local condition among the gray and fox squirrels of eastern United States, and a common condition on a large scale in some of the squirrels of southern Mexico and Central America.[1]

In a general way peculiarities of coloration among South American squirrels may be considered as indicative of group affinities.

Skull and teeth.

In attempting to discover tangible differences in the form of the skull and in the character of the teeth in American squirrels, with a view to their use as the basis of generic or subgeneric divisions, some surprises have been met with in respect to the variability of such features in specimens of the same

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[1] In the humid tropical lowlands of western Colombia, western Ecuador and adjoining portions of Peru, irregular small white spots, consisting of tufts of elongated white hairs, are of more or less frequent occurrence in all the squirrels inhabiting this region, including species of *Microsciurus, Mesosciurus,* and *Simosciurus.* They occur most frequently on the limbs and dorsal surface, but appear also on the ventral surface. Their contrast in color with the surrounding pelage renders them conspicuous marks, but they are obviously pathological, caused probably by bites of insects, and have no taxonomic significance.

species from the same locality. The dorsal contour of the skull varies with the age of the individual, and also in those of the same age, as does the relative development of the rostrum, the form of the nasals, and the relative interorbital breadth. These, however, are less disturbing than the variability in the form and in the details of the crown pattern of p^4 and m^3, and to a less extent in m^1 and m^2. Single skulls of various species were taken at random for photographing and for detailed study. In several instances what were thought to be important characters were discovered, and later when, to make sure of their diagnostic value, they were checked up by comparison with a series, it was found that their importance vanished, as the differences proved to be not constant.

Genera and Subgenera of American Tree Squirrels.

The American tree squirrels are separable into a number of fairly well circumscribed, and therefore natural, groups, not all, of course, of the same degree of differentiation. None are strictly congeneric with *Sciurus, sens. stric.*, typified by *Sciurus vulgaris* Linné of Europe and Northern Asia. In 1880 Trouessart, in his revision of the genus *Sciurus,*[1] divided the American species into five subgenera, as follows: (1) *Neosciurus,* (2) *Parasciurus,* (3) *Macroxus* (= *Guerlinguetus* Gray, 1821), (4) *Echinosciurus,* (5) *Tamiasciurus.* Another, *Microsciurus* Allen, was added in 1895. In 1899 all of them were accepted by Nelson (Proc. Washington Acad. Nat. Sci., I, pp. 15–106), who proposed four more, namely: (1) *Hesperosciurus,* (2) *Otosciurus,* (3) *Aræosciurus,* (4) *Baiosciurus.* Another, *Syntheosciurus,* was added as a full genus by Bangs in 1902, making eleven generic and subgeneric groups for the American tree squirrels found north of Panama. In June, 1914, Thomas added *Sciurillus,* as a full genus, for the pygmy squirrels of Guiana, which he referred to the subfamily Nannosciurinæ, previously known only from West Africa and the Malay Archipelago. In the present paper seven additional subdivisions are recognized for groups occurring only in South America, namely, *Notosciurus, Leptosciurus, Mesosciurus, Histriosciurus* (as a subgenus of *Mesosciurus*), *Hadrosciurus, Urosciurus,* and *Simosciurus.*

In 1912, G. S. Miller, Jr., in his 'List of North American Land Mammals' (Bulletin 79, U. S. Nat. Mus.), recognized 38 species and 58 additional subspecies (96 forms) of tree squirrels as occurring north of Panama, referred by him to three genera and three additional subgenera, four of the ten sub-

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[1] Revision du genre Écureuil (Sciurus), La Naturaliste, No. 37, pp. 290–293, Oct. 1, 1880.

genera recognized by Nelson in 1899 being suppressed, and *Sciurus* retained in a generic sense for all the species except those referred to *Microsciurus* and *Syntheosciurus*, which were accepted as full genera.[1]

As noted by Nelson, the subgenera recognized by him in 1899 "occupy clearly defined geographic areas and, without exception, the ranges of the most closely related groups are separated by a distinct gap" (*l. c.*, p. 24). *Tamiasciurus* is the most northern group, occupying the wooded temperate and cold temperate parts of North America, no member of the group occurring south of the 34th degree of latitude except in the higher mountain ranges. *Neosciurus* is restricted to the eastern half of the United States, nowhere reaching the Mexican border. *Hesperosciurus* is its representative on the west coast, where it occurs, chiefly in the mountain ranges, from western Washington to northern Lower California, its range slightly overlapping that of *Tamiasciurus*, with which it has no near genetic relationship. *Otosciurus* is restricted to the southern Rocky Mountains and the northern Sierra Madre of northern Mexico. *Parasciurus* is limited to the eastern United States, ranging (formerly) from central New York to Texas and the immediately adjoining portions of northeastern Mexico. *Arœosciurus* inhabits the mountains bordering the tableland of Mexico from about 6000 to 12,000 feet, and extends north into southwestern New Mexico and southern Arizona, and south to Pueblo and western Vera Cruz. The ranges of *Parasciurus* and *Arœosciurus* nearly meet in northeastern Mexico; while some of the forms differ slightly in cranial characters, *Arœosciurus* may well be united with *Parasciurus*.

The preceding six groups are warm temperate to boreal in their geographical ranges, while the following four are tropical. *Echinosciurus* ranges from southern Mexico south to Costa Rica and Panama, but does not extend into South America. It comprises all the large squirrels (some 50 species and subspecies) of this extensive and greatly diversified area. *Baiosciurus* is also tropical, ranging from central Tamaulipas through eastern Mexico to Nicaragua. *Guerlinguetus* (as recognized by Nelson, not *Guerlinguetus* Miller) is chiefly South American in its range, but extends north to northeastern Nicaragua. *Microsciurus* ranges from central Costa Rica south in the Andean region to Peru. *Syntheosciurus* is known only from the mountains of Chiriqui.

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[1] These 96 forms (38 species and 58 additional subspecies) were distributed as follows:
Subgenus *Tamiasciurus*, 21 forms, referred to 3 species.
Subgenus *Baiosciurus*, 4 forms, referred to 2 species.
Genus *Sciurus* (= *Echinosciurus*, *Neosciurus*, *Hesperosciurus*, *Otosciurus*), 50 forms, referred to 20 species.
Subgenus *Guerlinguetus*, 16 forms, referred to 9 species.
Genus *Microsciurus*, 4 forms, referred to 2 species.
Genus *Syntheosciurus*, 1 form.

In considering the genera and subgenera of South American squirrels it seems desirable to take into account also those of North America. The number of forms (species and subspecies) of American tree squirrels now known is about 175, a number likely to be considerably increased when those of South America become as well known as those of North America. Nearly as many more occurring in the Eastern Hemisphere are still more or less currently included in the genus *Sciurus,* but many referred a generation ago to *Sciurus* have since been segregated into a number of groups characterized originally as subgenera. Some of these divisions have come into use as full genera, but all of the American species are still commonly referred to *Sciurus.* *Sciurus* as generally accepted, is thus an unwieldy assemblage of several hundred species and subspecies, the considerable structural diversity and the relationships of which are concealed under a single generic name, although the mass includes many well circumscribed natural groups of admittedly superspecific value. The tendency is, on the part of recent specialists, to admit more and more of these groups to generic rank, in order to express more clearly the interrelationships and the diversities of their constituent elements. In line with this trend the present seems a favorable opportunity to call attention to the desirability of eliminating the genus *Sciurus* from the American biota and employing in its place such generic divisions as seem properly to express the diversity of the sciurid types of North and South America.

The tree squirrels collectively, morphologically, and in habits, are a singularly uniform group, due obviously to their strict adaptation to arboreal life. In *Sciuropterus* and *Pteromys,* the so-called flying squirrels, this adaptation is modified for pseudo flight, and they are not sciurid in a strict sense. The ground squirrels, beginning with *Tamias* and *Eutamias,* and including the spermophiles, prairie dogs and marmots, are adapted not only to terrestrial life, but have developed burrowing habits, with correlated modifications of structure.

The skull conforms closely throughout the group to a single type, of which the European tree squirrel (*Sciurus vulgaris* Linné) may be regarded as representative. In outline, as seen from above or below, the form varies from a broad to a long narrow oval outline; as seen in profile the dorsal outline varies from slightly convex or nearly straight to highly arched; the orbital fossa varies from subcircular to elongate, the greatest breadth of the fossa being usually at or slightly posterior to the postorbital processes; the interparietal is widely variable in both size and shape, but is generally similar in closely related forms; the maxillary teeth are either 4 or 5 on each side, and when p^3 is present it is greatly reduced in size; the cusps on the outer border of the molars, in unworn teeth, vary in prominence in different species, and may become greatly reduced in size or even obsolete. In respect to external features, the mammæ number either 6 or 8; the tail varies in length in accordance with the habits of the species. Taking the total length from the tip of the nose to the end of the tail vertebræ (not to the end of the hairs) as 100, the ratio of the length of the caudal vertebræ to the total length is found to vary only from about 40 to 52; in other words, from considerably less to slightly more than the head and body length. The limbs and feet, under the control of scansorial adaptation, are short and strong, with the hind limbs never lengthened. The rostrum and incisors are modeled for strength and efficiency in extracting the nutrient kernels from nuts and husks. Consequently although tree squirrels constitute a numerous group their arboreal adaptation restricts the range of their structural modifications to narrow limits. It is hence apparently desirable to emphasize such features of differentiation as may be available in order to indicate the genetic interrelationships of the considerable number of super-specific natural groups so long hidden under the old Linnæan name *Sciurus*.

North American genera.

My present views on the classification of North American tree squirrels are here presented, with diagnoses of the generic and subgeneric groups, and illustrations of cranial characters and dentition.

Genus **Tamiasciurus.**

Plate I[1], Figs. 10–12; Plate VI, Figs. 2, 3.

Tamiasciurus Trouessart, 1880 (subgenus of *Sciurus*). Type, by original designation, *Sciurus hudsonicus* Erxleben.

Size small (smallest of North American arboreal squirrels); tail short and narrow, about 40% of total length); coloration distinctive; a conspicuous black lateral line in summer pelage. Mammæ, 8.

Premolars, $\frac{2}{1}$, p^3 vestigial; dentition otherwise similar to that of restricted *Sciurus*. Skull rather narrow for the length, moderately convex, the highest point at the fronto-parietal suture; nasals short, narrow, posterior border obtusely V-shaped; length of nasals to total length, about 28% (35% in *S. vulgaris*); interorbital breadth to total length, 30% (37% in *S. vulgaris*); zygomatic breadth to total length, 56% (68% in *S. vulgaris*).

Species: *Tamiasciurus hudsonicus, T. douglasii, T. fremonti,* each with numerous subspecies.

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[1] For explanation of Plates I–VI, see pp. 179, 180.

Tamiasciurus, as the name implies, is on the border line between the terrestrial and arboreal types, and differs morphologically more from the other North American arboreal squirrels than any other sciurid group except *Microsciurus.* Figures of the skull and maxillary teeth are given in comparison with similar figures of *Sciurus vulgaris.*

Range.— The forested parts of the northern half of the North American continent.

Genus **Neosciurus.**

Plate III, Figs. 1–3; Plate VI, Figs. 12, 13.

Neosciurus Trouessart, 1880 (subgenus of *Sciurus*). Type, by original designation and monotypy, *Sciurus carolinensis* Gmelin.

Size medium; tail of medium length (about 46% of total length), broad and full; coloration not distinctive, gray above, white below. Mammæ, 8.

Premolars, $\frac{2}{1}$; p^3 small, not reaching the crown level of p^4; dentition not distinctive. Skull long and narrow, dorsal outline only slightly convex anterior to fronto-parietal suture; rostrum long and narrow, nasals narrow, moderately V-shaped on posterior border, about 33% of length of skull, 93% of interorbital breadth; zygomatic breadth 55% of total length.

Species: *Neosciurus carolinensis,* with numerous subspecies.

Range, eastern half of United States.

In cranial characters *Neosciurus* is similar to *Otosciurus* but it differs from it in external characters.

Genus **Otosciurus.**

Plate IV, Figs. 1–3; Plate VI, Fig. 16.

Otosciurus Nelson, 1899 (subgenus of *Sciurus*). Type, by original designation, *Sciurus aberti* Woodhouse.

Size large, tail long and full (about 48% of total length). Ears large, heavily tufted in winter; upperparts gray with a reddish dorsal area; underparts white; an indistinct black lateral line. Mammæ, 8.

Premolars, $\frac{2}{1}$, p^3 strongly developed; dentition otherwise, and also cranial characters, nearly as in *Neosciurus.*

Range, southern Rocky Mountain region, from northern Colorado to Chihuahua and Durango, west to Arizona.

Species: *Otosciurus aberti* (with numerous subspecies), *O. durangi,* and *O. kaibabensis.*

Genus **Hesperosciurus.**

Plate III, Figs. 4–6; Plate VI, Figs. 14, 15.

Hesperosciurus Nelson, 1899 (subgenus of *Sciurus*). Type, by original designation and monotypy, *Sciurus griseus* Ord.

Size very large, tail very long and full (about 50% of total length); coloration gray above, white below, without special markings. Mammæ, 8.

Premolars, $\frac{2}{1}$, p^3 heavily developed; m^3 with a single strongly developed conical cusp, with the accessory cusplets nearly suppressed; dentition otherwise as in *Neosciurus* and *Otosciurus*. Skull massive, heavily built, but contour and proportions nearly as in *Neosciurus* and *Otosciurus;* malar heavier, process of superior border better developed.

Range, Pacific coast of the United States, from southwestern Washington to northern border of Lower California.

Species: *Hesperosciurus griseus,* with several subspecies.

The practically monotypic genera *Neosciurus, Otosciurus,* and *Hesperosciurus* are closely related genetically but widely separated geographically; they have become strongly differentiated in external features, much less so in cranial characters and in dentition. *Otosciurus* and *Hesperosciurus* could very well stand as subgenera of *Neosciurus.*

Genus **Echinosciurus.**

Plate II, Figs. 1–8; Plate VI, Figs. 8–11.

Echinosciurus Trouessart, 1880 (subgenus of *Sciurus*). Type, by original designation, *Sciurus hypopyrrhus* Wagler (= *Sciurus aureogaster hypopyrrhus* Nelson).

Size large; tail long, about 50% of the total length (49 to 51 in different species); coloration variable; texture of pelage soft or hispid, according to the environment. Mammæ, 8.

Premolars, $\frac{2}{1}$, p^3 usually small, slender; molar dentition not distinctive. Skull broad, dorsal outline flattened or slightly swollen at frontal region; rostrum short, length of nasals about 95% of interorbital breadth (in the type species reaching 100% in some specimens).

Range, southern Mexico, south to northern Panama.

Species numerous (about 16, some of them with numerous subspecies), variable in cranial details.

The type species is a middle form in respect to the shape of the skull. The *E. poliopus, E. socialis* and *E. sinaloensis* groups have a longer rostrum and longer and posteriorly much narrower nasals; the *E. boothiæ, melania, thomasi, goldmani, variegatoides,* and *adolphei* groups a shorter and broader rostrum, wider and shorter nasals, and a broader skull than the *hypopyrrhus* (= *aureogaster*) group. The latter are tropical and southern, the former subtropical and northern, but they all blend so thoroughly that it seems impracticable to attempt to separate *Echinosciurus* into minor divisions. At the south *Echinosciurus* is sharply separated from all of the South American squirrels; at the north it is separated by a wide interval, geographically and in cranial characters, from either *Hesperosciurus* or *Neosciurus,* and in structural characters from *Otosciurus,* which ranges south into the mountains of northern Mexico.

Genus **Baiosciurus.**

Plate I, Figs. 7–9; Plate VI, Figs. 6, 7.

Baiosciurus Nelson, 1899 (subgenus of *Sciurus*). Type, by original designation, *Sciurus deppei* Peters.

Size medium; tail of medium length (about 47% of total length); coloration uniform grizzled dark rusty or yellowish brown above, grayish white with a buffy wash below; tail black fringed with white. Mammæ, 6.

Premolars, $\frac{2}{1}$, p^3 well-developed; p^4 small, crown nearly square; cusps on outer border of molars well-developed, the cusplets weakly developed. Skull broad, dorsal outline low; rostrum short, nasals about 27% of total skull length, 86% of interorbital breadth; zygomatic breadth about 58% of skull length.

Range, eastern Mexico, from central Tamaulipas to Chiapas, Guatemala, Honduras, and northern Nicaragua.

Species: 2, with several subspecies.

Baiosciurus is about twice the size of *Tamiasciurus,* and about half the size of *Mesosciurus hoffmanni,* taking the skull as a basis of comparison. It has 6 mammæ, as in *Mesosciurus* instead of 8 as in *Echinosciurus* and *Tamiasciurus.* It is too different from either of these genera in cranial characters to require detailed comparison. The quadrate instead of triangular form of p^4 in *Baiosciurus* is a distinguishing feature.

Genus **Syntheosciurus.**

Text Figs. 17–19; Plate VI, Fig. 1.

Syntheosciurus Bangs, 1902. Type, *Syntheosciurus brochus* Bangs, by designation and by monotypy.

Size small (about as in *Tamiasciurus*); tail of medium development, about 46% of total length. Pelage thick and soft; coloration about as in the *hoffmanni* group of *Mesosciurus*. Mammæ, 6.

Skull narrow, rostrum very long and narrow; nasals 103% of interorbital

Fig. 17.

Fig. 18.

Fig. 19.

Figs. 17–19. *Syntheosciurus brochus* Bangs. Type skull, nat. size.

breadth, 29% of total length of skull, their posterior border deeply emarginate; zygomatic breadth about 48% of skull length.

Premolars, $\frac{2}{1}$; incisors grooved in front; p^3 well developed; molariform dentition not specialized.

Known only from a single species, from Chiriqui, Panama, where it lives at an altitude of 7000 feet.

Syntheosciurus is surprisingly unlike any other known squirrel, having no very close relationship with its near neighbors, *Microsciurus* and *Mesosciurus*, which occur in the same region, and of course is very different from the large *Echinosciuri* of the same general area.

Genus **Parasciurus.**

Plate IV, Figs. 4–6; Plate V, Figs. 1–9; Plate VI, Figs. 17–24.

Parasciurus Trouessart, 1880 (subgenus of *Sciurus*). Type, *Sciurus niger* Linné, by monotypy.

Aræosciurus Nelson, 1889. Type, *Sciurus oculatus* Peters, by original designation.

Size large, among the largest of American tree squirrels; tail long and broad, about 50% of the total length. Pelage thick and soft; color of upperparts gray (generally dark gray with fulvous suffusion), underparts white or buffy, sometimes ferruginous. Mammæ, 8.

Skull broad and heavy, dorsal outline flattened over the frontal region, and occipital region relatively slightly depressed; rostrum and nasals broad, the latter well produced posteriorly, forming about 33% of the total length of the skull, their length about equal to the interorbital breadth (varying from 90 to 110% in specimens of the same species!); zygomatic breadth about 58% of length of skull.

Premolars, $\frac{1}{1}$; p^4 with (usually) a strong cusp on fronto-lateral border of crown; molars not distinctive.

Range, eastern United States, south in the mountains of the Mexican tableland to Pueblo and southern Jalisco, west to western Arizona, Sonora, and Sinaloa.

Species: 6, several with subspecies.

There seems to be no good reason for regarding *Aræosciurus* as separable from *Parasciurus*. The *P. niger* group is closely related to *P. apache* and *P. oculatus* (the latter the type of *Aræosciurus*) and the other species do not differ essentially from *niger*.

The skull of *Parasciurus* is similar in proportions to the skull in *Neosciurus, Otosciurus,* and *Hesperosciurus,* but the rostrum is broader and the occipital region is much less depressed; the premolar formula is $\frac{1}{1}$ instead of $\frac{2}{1}$, and p^4 is heavier and has the anterior cusp much more strongly developed, there being four well developed cusps on the outer border instead of only three, as in the genera having two premolars.

The two remaining genera of North American tree squirrels, *Mesosciurus* (*Guerlinguetus* auct., part) and *Microsciurus,* are intrusive from South America, where they have their principal distribution. The first, *Mesosciurus,* extends across the northern border of South America and throughout the Andean regions in the west to southern Ecuador. Its range in Central America is discontinuous with its South American range; it is known north of the Isthmus from Chiriqui to central Costa Rica, with an outlying member (*Mesosciurus richmondi*) in northeastern Nicaragua. The northernmost locality known for *Microsciurus* is central Costa Rica, whence it appears to extend continuously southward in the Western and Central Andes to southern Peru and neighboring parts of Bolivia.

South American genera.

The South American genera of tree squirrels are in general better circumscribed and more easily characterized than those of North America. They may be simply enumerated here, for comparison with the North American list, they being described in detail in the following pages.

Microsciurus Allen, 1895 (subgenus of *Sciurus*). Type, by original designation and monotypy, *Sciurus* (*Microsciurus*) *alfari* Allen.

Premolars, $\frac{2}{1}$; mammæ, 6. (For description see p. 188.)

Range, western Andean region, south to Peru and Bolivia, north to central Costa Rica. About 20 species and subspecies.

Sciurillus Thomas, 1914 (genus, referred to Nannosciurinæ). Type, by original designation, *Sciurus pusillus* Desmarest. (For description see p. 196.)

Premolars, $\frac{2}{1}$; mammæ, 6 (?).

Range, the Guianas. One species, with subspecies.

Leptosciurus gen. nov. (for description see p. 199). Type, *Sciurus rufoniger* Pucheran, not of Gray = *Funambulus pucheranii* Fitzinger.

Range, Andean Region of Colombia, and portions of Peru and Bolivia. Three species, several subspecies.

Notosciurus Allen, 1914. Type, by original designation and monotypy, *Notosciurus rhoadsi* Allen. (For description see p. 209.)

Range, Ecuador. Known only from the type specimen.

Mesosciurus gen. nov. (for description see p. 212). Type, *Sciurus æstuans* var. *hoffmanni* Peters.

Premolars, $\frac{1}{1}$; mammæ, 6.

Range, northeastern Nicaragua, northern border of South America, and the Andean region south to Ecuador. Numerous species and subspecies.

Histriosciurus (subgen. nov. of *Mesosciurus* (see pp. 213, 236)). Type, *Sciurus gerrardi* Gray.

Range, western and northern coast regions of Colombia.

Guerlinguetus Gray (subgenus of *Sciurus*). Type by tautonymy, *Sciurus guerlinguetus* Gray = *Sciurus æstuans* Linné. (For description see p. 254.)

Premolars, $\frac{1}{1}$; mammæ, 8.

Range, the Guianas, west to the Orinoco, the lower Amazon, and eastern Brazil. About 5 species and subspecies.

Hadrosciurus gen. nov. (for description see p. 265). Type, *Sciurus flammifer* Thomas.

Premolars, $\frac{1}{1}$; mammæ, 8.

Range, Caura district, Rio Orinoco. Known only from the type species.

Urosciurus gen. nov. (for description see p. 267). Type, *Sciurus tricolor* Pœppig.

Premolars; $\frac{1}{1}$; mammæ, 8.

Range, basin of the Amazon. About 5 species, with numerous subspecies.

Simosciurus gen. nov. (for description see p. 280). Type, *Sciurus stramineus* Eydoux and Souleyet.

Premolars, $\frac{1}{1}$; mammæ, 8.

Range, southwestern Ecuador and northwestern Peru. One species, with several subspecies.

EXPLANATION OF PLATES I–VI.

Plate I.

All figures nat. size.

Figs. 1–3. *Sciurus vulgaris leucourus* Kerr. No. 36596, Am. Mus., ♂ ad., Burnham Beeches, England. For comparison with American types.

Figs. 7–9. *Baiosciurus deppei vivax* Nelson. No. 107928, U. S. Nat. Mus., ♂ ad., Apazote, Campeche, Mexico.

Figs. 10–12. *Tamiasciurus hudsonicus gymnicus* (Bangs). No. 8205, Am. Mus., ♂ ad., Forks of Tobique River, New Brunswick.

Plate II.

All figures nat. size.

Figs. 1–3. *Echinosciurus aureogaster hypopyrrhus* (Wagler). No. 17196, Am. Mus., ♂ ad., Pasa Nueva, Vera Cruz, Mexico.

Figs. 4, 5. *Echinosciurus poliopus cervicalis* (Allen). No. 26050, Am. Mus., ♂ ad., Volcan de Fuego, Jalisco, Mexico.

Figs. 6, 7. *Echinosciurus variegatoides variegatoides* (Ogilby). No. 30753, Am. Mus., ♂ ad., Matagalpa, Nicaragua.

Fig. 8. *Echinosciurus melania* (Gray). No. 18867, Am. Mus., ♂ ad., Boqueron, Chiriqui.

Plate III.

All figures nat. size.

Figs. 1–3. *Neosciurus carolinensis carolinensis* (Gmelin). No. 2486, Am. Mus., ♀ ad., Hastings, Westchester Co., New York.

Figs. 4–6. *Hesperosciurus griseus griseus* (Ord). No. 11863, Am. Mus., ♀ ad., Colusa Co., California.

Plate IV.

All figures nat. size.

Figs. 1–3. *Otosciurus aberti aberti* (Woodhouse). No. 1686, Am. Mus., ♀ ad., Mogollon Mts., Arizona.

Figs. 4–6. *Parasciurus arizonensis arizonensis* (Coues). No. 1706, Am. Mus., ♀ ad., Fossil Creek, Arizona.

Plate V.

All figures nat. size.

Figs. 1, 2. *Parasciurus niger rufiventer* (Geoffroy). No. 2508, Am. Mus., ♂ ad., Tangipaho Parish, Louisiana.

Figs. 5, 6. *Parasciurus oculatus oculatus* (Peters). No. 10886, Am. Mus., ♂ ad., Las Vigas, Vera Cruz, Mexico.

Figs. 8, 9. *Parasciurus apache* (Allen). No. 21353, ♀ ad., Arroyo de Bucy, Durango, Mexico.

PLATE VI.

All figures $\frac{3}{1}$.

Fig. 1. *Syntheosciurus brochus* Bangs. *Type.* No. 10402, Bangs Coll., Mus. Comp. Zoöl., ♂ ad. Left maxillary toothrow, direct crown view.

Fig. 2. *Tamiasciurus hudsonicus gymnicus* (Bangs). No. 8205, Am. Mus., ♂ ad., Tobique River, New Brunswick. Maxillary toothrows, direct crown view.

Fig. 3. Same specimen as Fig. 2. Oblique view of left maxillary toothrow, to show crenulation of outer border.

Fig. 4. *Sciurus vulgaris leucourus* Kerr. No. 36596, Am. Mus., ♀ ad., Slough, England. Left maxillary toothrow, direct crown view. For comparison with American types.

Fig. 5. Same specimen as Fig. 4. Oblique view of left maxillary toothrow.

Fig. 6. *Baiosciurus deppei matagalpæ* Allen. No. 29812, Am. Mus., ♂ ad., Pena Blanca, Nicaragua. Maxillary toothrows, direct crown view.

Fig. 7. Same specimen as Fig. 6. Oblique view of left maxillary toothrow.

Fig. 8. *Echinosciurus aureogaster hypopyrrhus* (Wagner). No. 17196. Am. Mus., ♀ ad., Pasa Nueva, Vera Cruz, Mexico. Direct crown view of left maxillary toothrow.

Fig. 9. Same specimen as Fig. 8. Oblique view of left maxillary toothrow.

Fig. 10. *Echinosciurus poliopus cervicalis* (Allen). No. 26050, Am. Mus., ♂ ad., Volcan de Fuego, Jalisco, Mexico. Direct crown view of left maxillary toothrow.

Fig. 11. Same specimen as Fig. 10. Oblique view of left maxillary toothrow.

Fig. 12. *Neosciurus carolinensis carolinensis* (Gmelin). No. 2486, Am. Mus., ♀ ad., Hastings, Westchester Co., New York. Direct crown view of left maxillary toothrow.

Fig. 13. Same specimen as Fig. 12. Oblique view of left maxillary toothrow.

Fig. 14. *Hesperosciurus griseus griseus* (Ord). No. 11863, Am. Mus., ♂ ad., Colusa Co., California.

Fig. 15. Same specimen as Fig. 12. Oblique view of left maxillary toothrow.

Fig. 16. *Otosciurus aberti aberti* (Woodhouse). No. 1686, Am. Mus., ♀ ad., Mogollon Mts., Arizona. Direct crown view of left maxillary toothrow.

Fig. 17. *Parasciurus niger rufiventer* (Geoffroy). No. 2508, Am. Mus., ♂, Tangipaho Parish, Louisiana. Direct crown view of left maxillary toothrow.

Fig. 18. Same specimen as Fig. 17. Oblique view of left maxillary toothrow.

Fig. 19. *Parasciurus arizonensis arizonensis* (Coues). No. 1706, Am. Mus., ♀ ad., Fossil Creek, Arizona. Crown view of left maxillary toothrow.

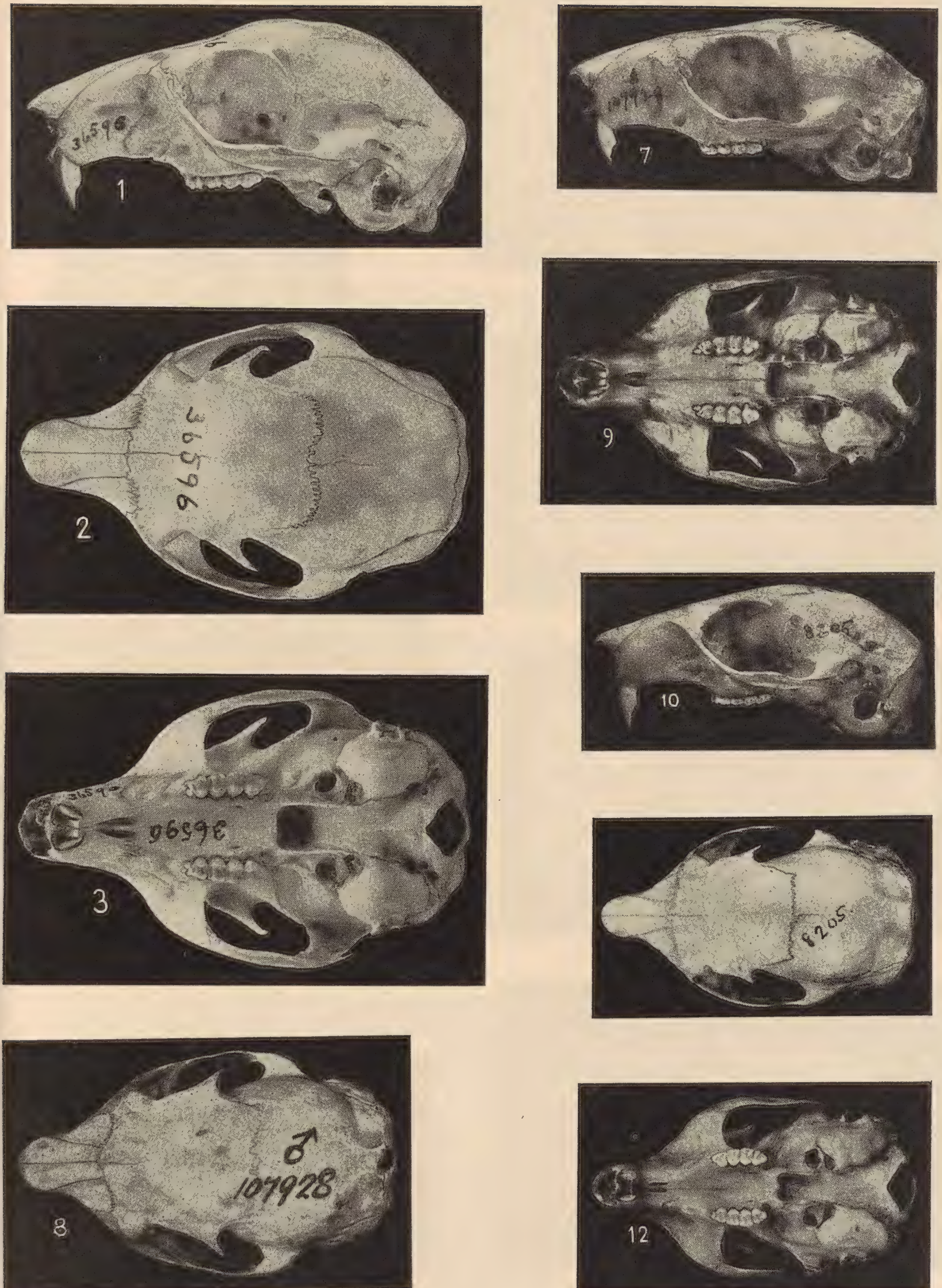
Fig. 20. Same specimen as Fig. 19. Oblique view of left maxillary toothrow.

Fig. 21. *Parasciurus apache* (Allen). No. 21353. Am. Mus., ♀ ad., Arroyo de Bucy, Durango, Mexico. Crown view of left-maxillary toothrow.

Fig. 22. Same specimen as Fig. 21. Oblique view of left maxillary toothrow.

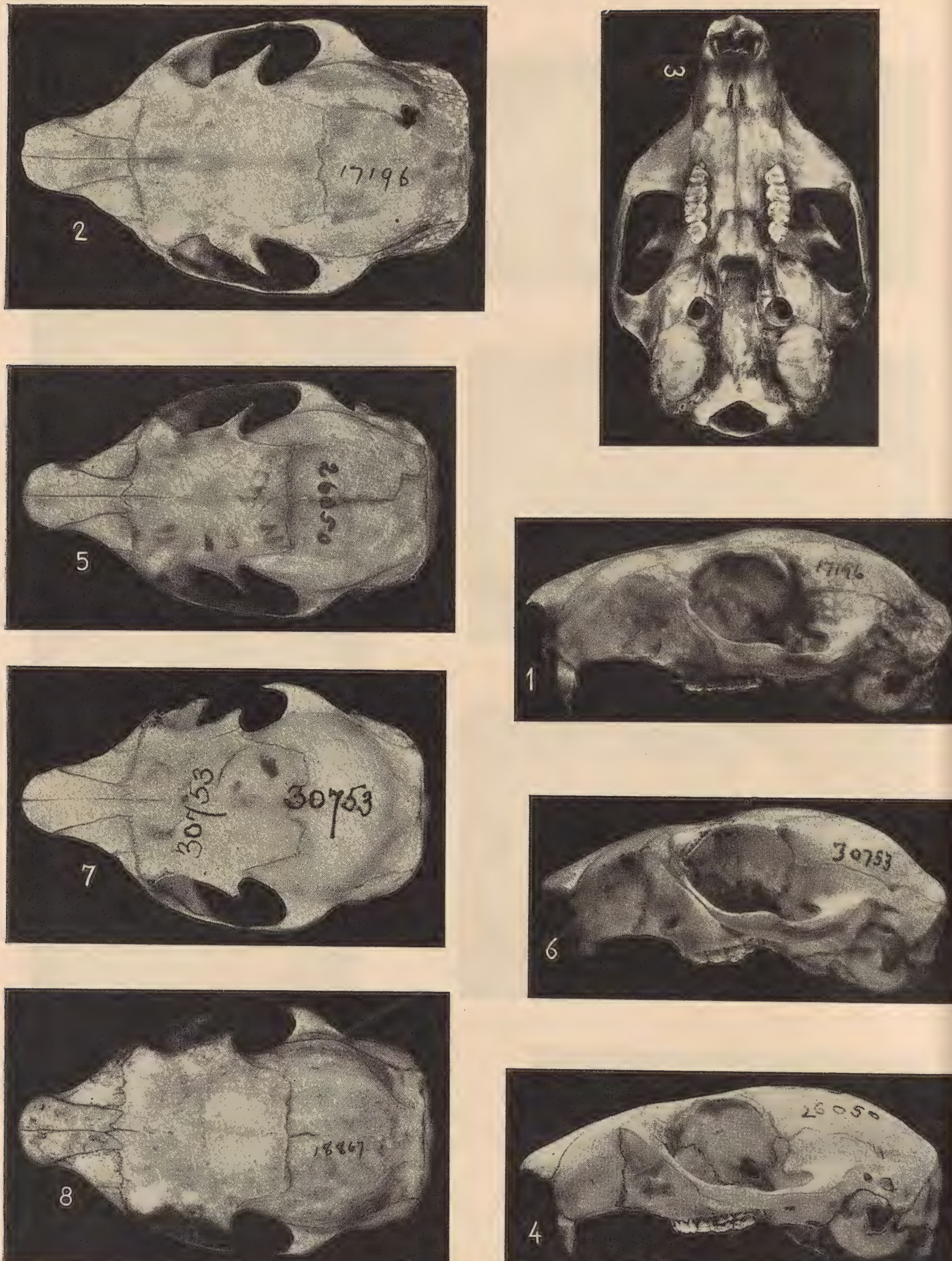
Fig. 23. *Parasciurus oculatus oculatus* (Peters). No. 10886, Am. Mus., ♂ ad., Las Vigas, Vera Cruz, Mexico. Left maxillary toothrow, direct crown view.

Fig. 24. Same specimen as Fig. 23. Oblique view of left maxillary toothrow.



All figures nat. size.

Figs. 1–3. Sciurus vulgaris leucourus. Figs. 7–9. Baiosciurus deppei vivax.
Figs. 10–12. Tamiasciurus hudsonicus gymnicus.



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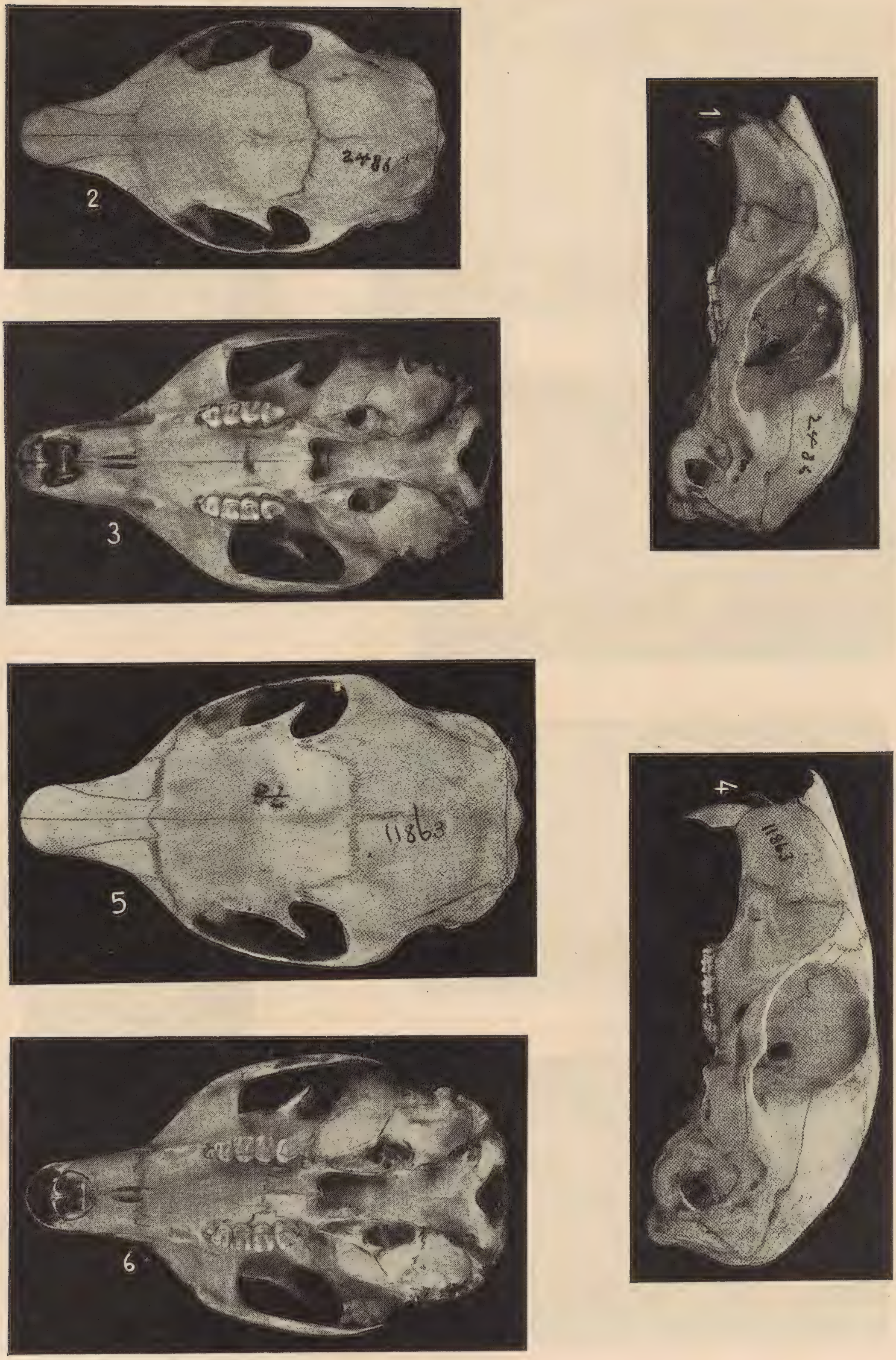
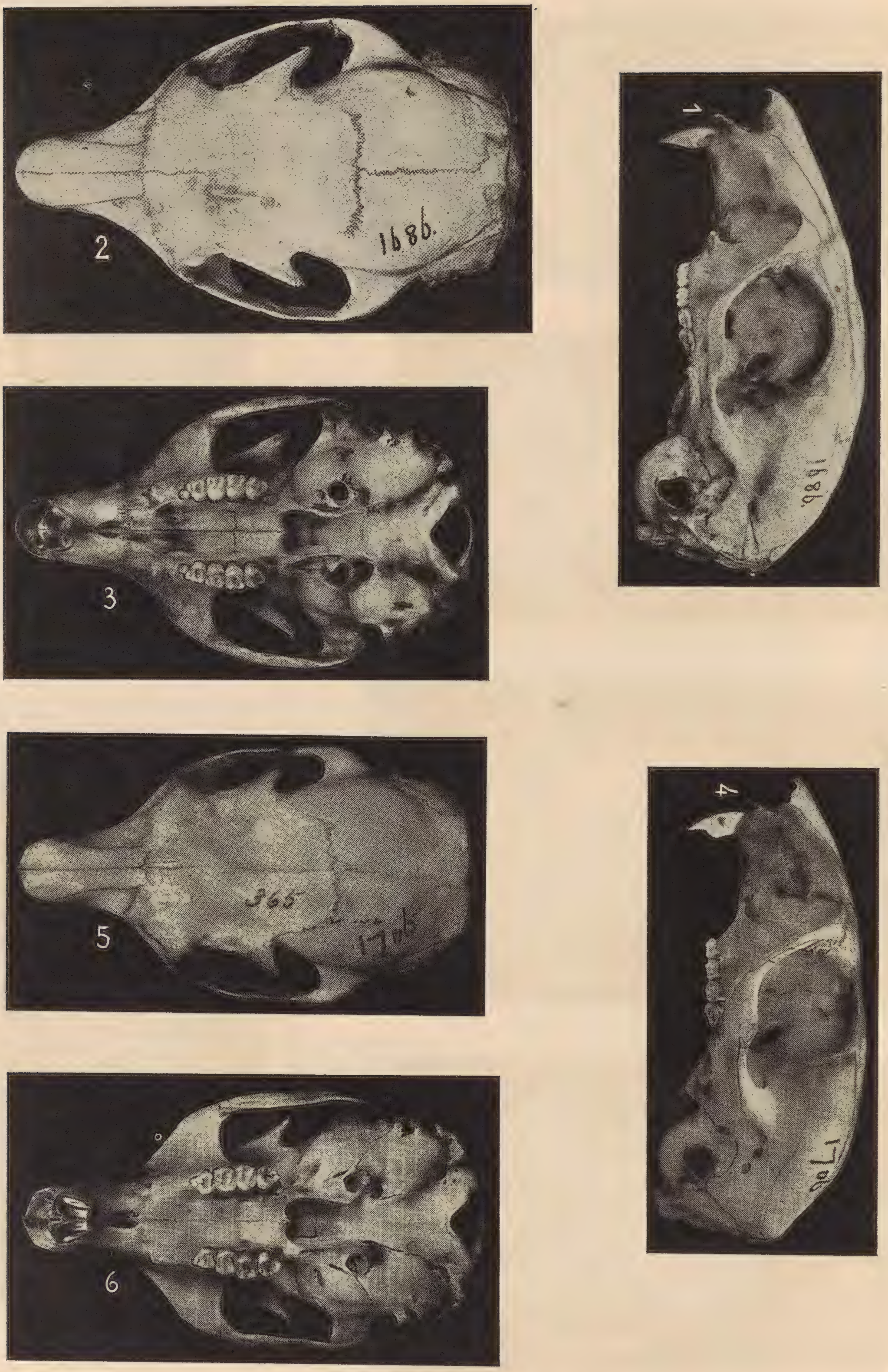
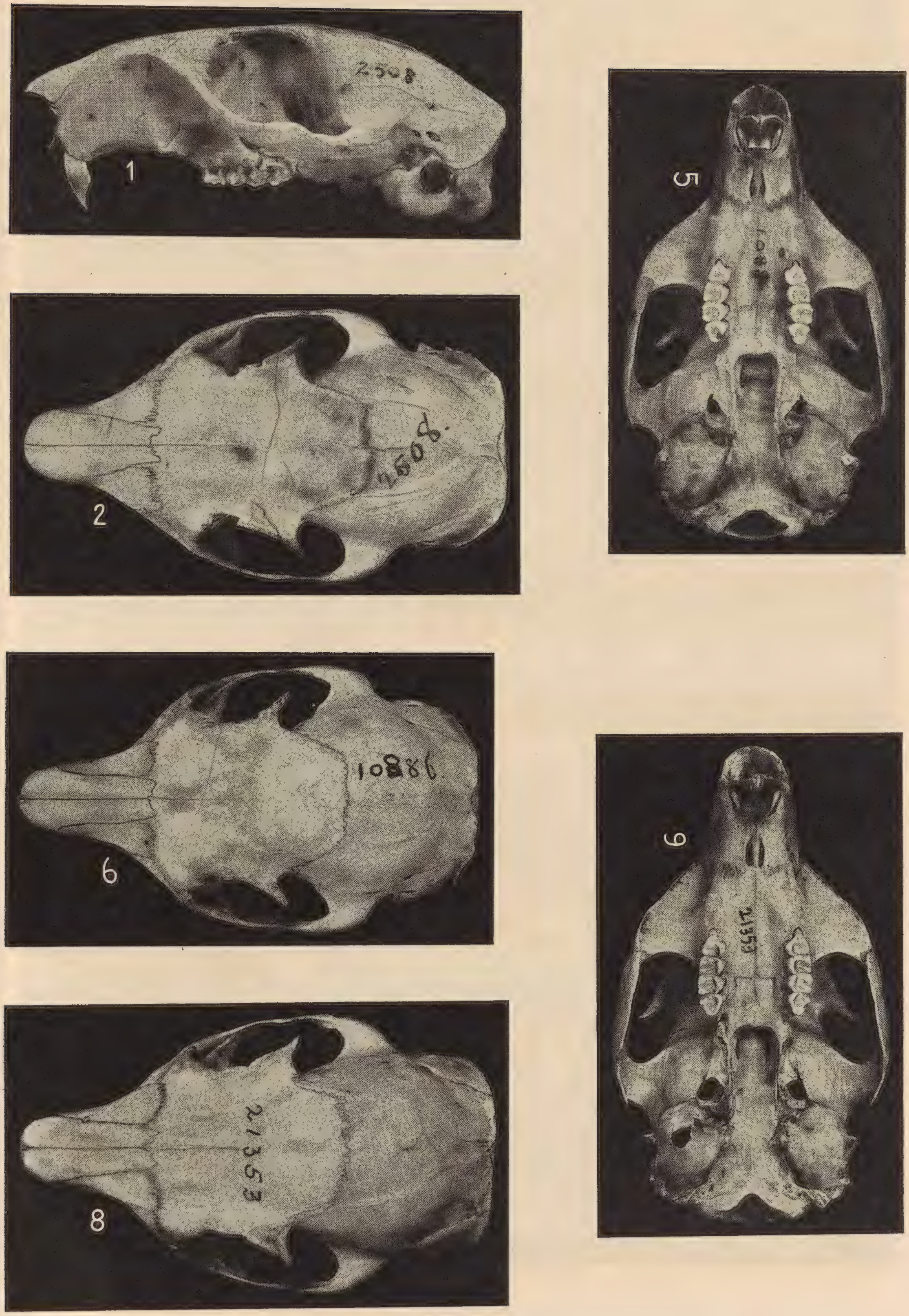
Figs. 1–3. Echinosciurus aureogaster hypopyrrhus.
" 4, 5. " poliopus cervicalis.
" 6, 7. " variegatoides variegatoides.
" 8. " melania.



All figures nat. size.
Figs. 1–3. Neosciurus carolinensis carolinensis.
" 4–6. Hesperosciurus griseus griseus.



All figures nat. size.
Figs. 1–3. Otosciurus aberti aberti.
" 4–6. Parasciurus arizonensis arizonensis.



All figures nat. size.

Figs. 1, 2. Parasciurus niger rufiventer. Figs. 5, 6. Parasciurus oculatus oculatus.

Figs. 8, 9. Parasciurus apache.

All figures $\frac{3}{1}$

Fig. 1. Syntheosciurus brochus.
" 2, 3 Tamasciurus hud. gymnicus.
" 4, 5 Sciurus vulgaris leucourus.
" 6. 7. Baiosciurus deppei matagalpæ.
" 8, 9. Echinosciurus aureo. hypopyrrhus.
" 10. 11. " poliopus cervicalis.

Figs. 12, 13. Neosciurus car. carolinensis.
" 14, 15. Hesperosciurus gr. griseus.
" 16. Otosciurus aberti aberti.
" 17, 18. Parasciurus niger rufiventer.
" 19, 20. " ariz. arizonensis.
" 21, 22. " apache.

Figs. 23, 24. Parasciurus oculatus oculatus.

South American Sciuridæ.

In the following pages the tree squirrels of South America are divided into nine natural and, for the most part, geographically and morphologically well-circumscribed groups. They are here treated, partly for nomenclatural convenience, as full genera. Their ultimate valuation will naturally vary with the viewpoint of the taxonomer. The reasons for this proposed subdivision have already been stated (pp. 169–172). Illustrations of the cranial characters are given of the leading types in Plates VII–XIV.[1]

The forms here recognized (including 5 from Central America) number 76, of which 38 are given the status of species, with 38 additional subspecies. The 'giant' squirrels of the Amazonian region are unfortunately poorly represented in the material available for study, and the recognition accorded to several of the forms of this group is merely provisional.

Five genera (*Leptosciurus, Mesosciurus, Hadrosciurus, Urosciurus, Simosciurus*), one subgenus (*Histriosciurus*), and two subspecies (*Guerlinguetus æstuans venustus, Mesosciurus gerrardi baudensis* and *M. g. valdiviæ*) are here characterized as new. [For the last two see Addenda, p. 308.]

Key to the Genera.[2]

Mammæ, 6.
- Premolars, $\frac{2}{1}$.
  - Size small, total length about 240–260 mm., hind foot 35–40; tail much shorter than head and body .... *Microsciurus* (p. 188)
  - Size very small, total length about 220 mm., hind foot about 28; tail as long as or longer than the body .... *Sciurillus* (p. 196)
- Premolars, $\frac{1}{1}$.
  - Size small, total length about 320–380, hind foot 40–45; tail shorter than head and body.
    - Soles naked, plantar pads normal .... *Leptosciurus* (p. 199)
    - Soles heavily furred nearly the whole length, plantar pads all near base of toes .... *Notosciurus* (p. 209)
  - Size medium, total length about 375–450 mm., hind foot 50 to 55; tail about equal to or shorter than head and body .... *Mesosciurus* (p. 212)

Mammæ, 8; premolars, $\frac{1}{1}$; tail as long as or longer than head and body.
- Size small, tail narrow .... *Guerlinguetus* (p. 254)
- Size large, total length 490–580, tail broad and bushy.
  - Skull broad and heavy, rostrum short ...... *Hadrosciurus* (p. 265)
  - Skull long and narrow, rostrum slender .... *Urosciurus* (p. 267)
- Size large, tail very long and narrow, skull short, rostrum very short and broad .... *Simosciurus* (p. 280)

[1] For explanation of the Plates (Pll. VII–XIV) see pp. 286–288.

[2] For maps showing the distribution of the genera see pp. 298–301. For a sketch-map showing localities in southwestern Colombia from which squirrels have been examined in the preparation of this review, see this Bulletin, Vol. XXXIII, 1914, pl. xiii.

Genus **Microsciurus** *Allen.*

Plate VII, Figs. 4–6; Plate XIII, Figs. 3, 4; Text Fig. 1 (p. 162).

Microsciurus Allen, Bull. Amer. Mus. Nat. Hist., VII, p. 332, Nov. 8, 1895 (subgenus of *Sciurus*).— Nelson, Proc. Washington Acad. Sci., I, p. 32, pl. i, fig. 6, pl. ii, fig. 2, May, 1899 (subgenus of *Sciurus*).— Goldman, Smithson. Misc. Coll., LVI, No. 36, p. 4, Feb. 12, 1912 (genus).— Miller, Bull. 79, U. S. Nat. Mus., p. 338, 1912 (genus).— Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, pp. 145–165 (genus; monographic review).

Type, *Sciurus* (*Microsciurus*) *alfari* Allen.

Smallest of the American tree squirrels, except *Sciurillus*. Total length about 240 to 260 mm.; tail short and narrow, tail vertebræ about 40% of the total length (*i. e.*, tip of nose to end of tail vertebræ). Mammæ, 6.

Premolars, $\frac{2}{1}$. Skull short, broad, and deep; greatest width near the front border of the zygomatic fossæ (at m^1), equal to about 60% of total length of skull; dorsal outline highly arched, the highest point at the postorbital processes; nasals short and broad, their length about 28% of the total length of the skull, and about 76% of the interorbital breadth; breadth of braincase 50% of total skull length. Orbital fossa circular, when seen from above nearly closed posteriorly, the open space behind the postorbital process very small instead of forming one third or more of the whole space, as in other tree squirrels; zygomata converging posteriorly instead of anteriorly; malar broad, with a deep depression in the superior border just behind the middle, as in *Nannosciurus*. Upper molars nearly normal in form and position, parastyle, mesostyle, and metastyle strongly and about equally developed in p^4, m^1 and m^2, without the intermediate cusplets usually present; transverse ridges on crown strongly developed, but directed obliquely internoposteriorly instead of transversely or anteriorly; p^4 is nearly as large as m^3 and similar to it in outline; p^3 is a well developed column reaching the level of the other teeth, with often a bicuspid functional crown.

Geographic distribution.— The western Andean region of Colombia, south to the southern border of Peru, north to central Costa Rica. Represented by 17 described species and subspecies. (See Map, p. 298.)

Remarks.— The distinctive external features of the genus are small size, a short narrow tail, and usually prominent postauricular patches of long soft whitish or buffy hair. The shape of the skull is widely different from that of ordinary sciurids, the dorsal outline being much more convex, the braincase greatly expanded and deep, the greatest expansion of the zygomatic arches near the front border instead of at the middle or posterior to the middle. The well developed and functional p^3 is rarely absent.

In a few characters *Microsciurus* resembles *Nannosciurus*, but in other features the two genera are widely unlike, whatever may be the case with *Sciurillus*. The skull of the latter I have been unable to examine. (For comparative figures of the skulls and teeth of *Nannosciurus* and *Microsciurus*, see Plates VII and XIII.)

The known distribution of the genus *Microsciurus* is the Andean region of South America, excluding the Bogotá district, from the southern border of Peru northward to Panama, and thence through Panama to central Costa Rica, from sea-level to about 8000 feet. Little is yet known of the limits of distribution of the species and subspecies, a number of which are at present known only from their type localities.

Heretofore almost nothing has been recorded of the habits of these squirrels. The following notes by Mr. Leo E. Miller, who has collected a considerable number of these animals in western Colombia for the American Museum of Natural History, are therefore most welcome. He says:

"I have always found the *Microsciuri* much rarer than other squirrels, and usually in pairs. They seem to prefer the palm forests that are so abundant on the hillsides, where they feed on the various kinds of palm fruits and nuts. They invariably evince considerable curiosity, and can be approached to within a short distance before taking fright and hiding in the palm leaves. They move rapidly and gracefully, making long, daring leaps. In running over the leaves or branches they follow the lateral stems, and on reaching the end, leap to another and repeat the same performance; other squirrels frequently ascend through the tree top or thick foliage by leaping crosswise from twig to twig, as if leaping from one ladder rung to another. But my experience with them is not extensive enough to enable me to say that this is always the case."

Following is a revised list of the species and subspecies, as now recognized, with their type localities, and a statement of the number of specimens of each examined in the preparation of the present review.

Microsciurus alfari alfari Allen. Volcano Turrialba, near Jiménez, Costa Rica. Specimens examined, 6, including the type.

Microsciurus alfari venustulus Goldman. Gatun, Canal Zone, Panama. Specimens examined, 4, including the type and a topotype.

Microsciurus alfari browni Bangs. Bogaba, Chiriqui, Panama; altitude 600 feet. Specimens examined, 3 topotypes.

Microsciurus boquetensis Nelson. Boquete, Chiriqui, Panama; altitude 6000 feet. Specimens examined, 2, type and topotype.

Microsciurus similis similis Nelson. Cali, Western Andes, Colombia; altitude 6000 feet. Specimens examined, 12, including the type.

Microsciurus similis fusculus Thomas. Juntas, Rio San Juan, Chocó district, Colombia; altitude 400 feet. Specimens examined, 5, including the type and two topotypes.

Microsciurus otinus Thomas. Medellin, Colombia. Specimens examined, 3, including the type and a topotype. [See Addenda, p. 307.]

Microsciurus isthmius isthmius Nelson. Rio Truandó, Isthmus of Darien, Colombia. Specimens examined, 10, including the type and a topotype.

Microsciurus isthmius vivatus Goldman. Near Cana, eastern Panama; altitude 3500 feet. Specimens examined, 3, the type and 2 topotypes.

Microsciurus mimulus Thomas. Cachavi, Esmeraldas, Ecuador; altitude 560 feet. Specimens examined, 14, including the type and 2 topotypes.

Microsciurus palmeri Thomas. Sipi, Chocó district, Colombia; altitude 150 feet. Specimens examined, 12, including the type and 7 paratypes (one of them a topotype).

Microsciurus simonsi Thomas. Porvenir, Bolivar Province, Ecuador; altitude 5000 feet. Specimens examined, 1, the type.

Microsciurus peruanus Allen. Guayabamba, Peru; altitude 4000 feet. Specimens examined, 1, the type.

Microsciurus napi Thomas. Mouth of Rio Coco, upper Rio Napo, Ecuador. Specimens examined, 1, the type.

Microsciurus brevirostris Allen. Chanchamayo, central Peru; altitude 5000–5300 feet. Specimens examined, 5, including the type.

Microsciurus florenciæ Allen. Florencia, Caquetá district, Colombia; altitude 1000 feet. Specimens examined, 4, including the type.

Microsciurus avunculus Thomas. Gualaquiza, Ecuador; altitude 2500 feet; specimens examined, none.

This list differs from the one given in my paper on *Microsciurus* published in February, 1914 (this Bulletin, XXXIII, pp. 145–165), through the omission of three species and the addition of one, the latter described since its publication. Of the three omitted one, *chrysuros*, is now referred to *Leptosciurus* (see below, p. 200), and two, *pusillus* and *kuhlii*, to *Sciurillus*, since established by Thomas, who refers *kuhlii* to *pusillus* as a synonym. These three forms were unrepresented in the material available to me for examination. The number of forms now recognized is 17, of which 13 are given the rank of species, with 4 additional subspecies.

The bibliographical references, the type localities, and the geographic ranges of the above forms here follow; but the descriptions (given in the former paper) are omitted.

Microsciurus alfari alfari *Allen.*

Sciurus (Microsciurus) alfari Allen, Bull. Amer. Mus. Nat. Hist., VII, p. 333, Nov. 8, 1895.

Sciurus alfari Nelson, Proc. Washington Acad. Sci., I, p. 105, pl. i, fig. 6, pl. ii, fig. 2, May 9, 1899. Type skull figured.

Microsciurus alfari Miller, Bull. 79, U. S. Nat. Mus., p. 338, 1912.

Microsciurus alfari alfari Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 149, Feb. 26, 1914.

Type locality.— Volcan de Turrialba, near Jiménez, Costa Rica.

Geographic distribution.— Known only from central Costa Rica.

Microsciurus alfari venustulus *Goldman.*

Microsciurus alfari venustulus Goldman, Smithson. Misc. Coll., LVI, No. 36, p. 4, Feb. 19, 1912.— Miller, Bull. 79, U. S. Nat. Mus., p. 338, 1912.— Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 150, Feb. 26, 1914.

Type locality.— Gatun, Canal Zone, Panama.

Geographic distribution.— Known only from the Canal Zone, Panama.

Microsciurus alfari browni *Bangs.*

Sciurus (Microsciurus) browni Bangs, Bull. Mus. Comp. Zoöl., XXXIX, p. 24, April, 1902.

Microsciurus browni Miller, Bull. 79, U. S. Nat. Mus., p. 338, 1912.

Microsciurus alfari browni Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 151, Feb. 26, 1914.

Type locality.— Bogabo, Chiriqui, Panama; altitude 600 feet.

Geographic distribution.— Known only from the type locality.

Microsciurus boquetensis *Nelson.*

Sciurus (Microsciurus) boquetensis Nelson, Proc. Biol. Soc. Washington, XVI, p. 121, Sept. 30, 1903.

Microsciurus boquetensis Miller, Bull. 79, U. S. Nat. Mus., p. 338, 1912.— Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 151, Feb. 26, 1914.

? *Sciurus rufoniger* Alston, Proc. Zool. Soc. London, 1878, p. 669. Veragua, Panama. Not *S. rufoniger* Gray, 1842, nor of Allen, 1877.

Type locality.— Boquete, Chiriqui, Panama; altitude 6000 feet.

Geographic distribution.— Known only from the type locality.

Microsciurus similis similis *Nelson.*

Sciurus (Microsciurus) similis Nelson, Bull. Amer. Mus. Nat. Hist., XII, p. 78, April 14, 1899.— Allen, *ibid.*, XXXI, p. 92, April 19, 1912.

Microsciurus similis similis Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 153, Feb. 26, 1914.

Type locality.— Near Cali, Western Andes, Colombia; altitude 6000 feet.

Geographic distribution.— Colombia; Western and Central Andes at altitudes of 4000 to 7200 feet.

Microsciurus similis fusculus *Thomas.*

Sciurus (Microsciurus) similis fusculus Thomas, Ann. and Mag. Nat. Hist. (8), VI, p. 503, Nov. 1910.

? *Microsciurus similis fusculus* Lönnberg, Arkiv. för. Zool., VIII, No. 16, p. 26, July 12, 1913. Near Gualea, Ecuador.

Microsciurus similis fusculus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 154, Feb. 26, 1914.

Type locality.— Juntas, Rio San Juan, Chocó district, Colombia; altitude 400 feet.

Geographic distribution.— Known only from the Chocó district, Colombia.

Microsciurus otinus *Thomas.*

Sciurus (Microsciurus) otinus Thomas, Ann. and Mag. Nat. Hist. (7), VII, p. 193, Feb., 1901.

Microsciurus otinus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 156, Feb. 26, 1914.

Type locality.— Medellin, Colombia.

Geographic distribution.— Recorded only from Medellin and Valdivia, at altitudes of about 3000 to 4000 feet.

Microsciurus isthmius isthmius *Nelson.*

Sciurus (Microsciurus) isthmius Nelson, Bull. Amer. Mus. Nat. Hist., XII, p. 77, April 14, 1899.

Microsciurus isthmius isthmius Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 157, Feb. 26, 1914.

Type locality.— Truandó River, Isthmus of Darien, Colombia.

Geographic distribution.— Coast region of Colombia from the Truandó River south to the Rio San Juan, Chocó district.

Microsciurus isthmius vivatus *Goldman.*

Microsciurus isthmius vivatus Goldman, Smithson. Misc. Coll., LX, No. 2, p. 4, Sept. 20, 1912.— Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 158, Feb. 26, 1914.

Type locality.— Near Cana, Pirri range, eastern Panama; altitude 3500 feet.

Geographic distribution.— Known only from the type locality.

Microsciurus mimulus *Thomas.*

Sciurus (*Microsciurus*) *mimulus* Thomas, Ann. and Mag. Nat. Hist. (7), II, p. 266, Sept. 1898.

Microsciurus mimulus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 158, Feb. 26, 1914.

Type locality.— Cachavi, Esmeraldas, Ecuador; altitude about 665 feet.

Geographic distribution.— Coast region of northwestern Ecuador and southwestern Colombia.

Microsciurus palmeri *Thomas.*

Sciurus (*Microsciurus*) *palmeri* Thomas, Ann. and Mag. Nat. Hist. (8), IV, p. 234, Sept. 1909.

Microsciurus palmeri Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 160, Feb. 26, 1914.

Type locality.— Sipi, Rio Sipi, tributary of Rio San Juan, Chocó district, Colombia; altitude 150 feet.

Geographic distribution.— Coast region (Chocó district) of western Colombia.

Microsciurus simonsi *Thomas.*

Sciurus (*Microsciurus*) *simonsi* Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 294, Sept. 1900.

Microsciurus simonsi Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 161, Feb. 26, 1914.

Type locality.— Porvenir, near Zaparal, Bolivar province, Ecuador; altitude, 1500 m. (5000 feet).

Geographic distribution.— Known only from the type locality.

Microsciurus peruanus *Allen.*

Sciurus (*Microsciurus*) *peruanus* Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 115, April 26, 1897.

Microsciurus peruanus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 161, Feb. 26, 1914.

Type locality.— Guayabamba, northwestern Peru; altitude 4000 feet.

Geographic distribution.— Known only from the type locality.

Microsciurus napi *Thomas.*

Sciurus (*Microsciurus*) *napi* Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 295, Sept. 1900.

Microsciurus napi Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 163, Feb. 26, 1914.

Type locality.— Mouth of Rio Coco, upper Rio Napo, on the Ecuador-Colombia boundary.

Geographic distribution.— Known only from the type locality.

Microsciurus rubrirostris *Allen.*

Sciurus chrysurus Thomas (not of Pucheran), Proc. Zool. Soc. London, 1893, p. 333, La Gloria, Chanchamayo, Peru.

Microsciurus rubrirostris Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 163, Feb. 26, 1914.

Type locality.— Chanchamayo, central Peru; altitude 2000 m. (about 6700 feet).

Geographic distribution.— Known only from the type locality.

Microsciurus florenciæ *Allen.*

Microsciurus florenciæ Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 164, Feb. 26, 1914.

Type locality.— Florencia, Caquetá district, southwestern Colombia; altitude about 1000 feet.

Geographic distribution.— Known only from the vicinity of the type locality.

Microsciurus avunculus *Thomas.*

Microsciurus avunculus Thomas, Ann. and Mag. Nat. Hist. (8), XIII, p. 574, June, 1914.

Type locality.— Gualaquiza, eastern Ecuador; altitude 2500 feet.

Geographic distribution.— Known only from the type locality.

Description.— "Closely similar to *M. napi,* but markedly larger throughout.

"Size a little larger than in any described species. General colour above finely grizzled olive-brown, the fore back slightly greyer, the hind back warmer. Chest greyish 'cinnamon-buff,' not such a bright ochraceous as in *M. rubrirostris;* belly and inner sides of hind limbs dull tawny, toned down by the slaty bases of the hairs. Crown finely ticked with ochraceous, a little warmer than nape, more like back, not so ochraceous as in *rubrirostris.* Ears with their inner surface grizzled ochraceous; outer surface grey anteriorly, with a large whitish patch posteriorly, the upper part of this patch buffy. Hands and feet grizzled ochraceous. Edges of tail pale buffy.

"Skull conspicuously larger than that of *napi,* about as in *M. rubrirostris.*

"Dimensions of the type:— Hind foot, s. u. 39, c. u. 42 mm.; ear 15.

"Skull: tip of nasals to front of interparietal 35.5; condylo-incisive length 34; zygomatic breadth 23.3; nasals 11 × 4.8; interorbital breadth 14.2; breadth of brain-case 19; palatal length 16; tooth-row (exclusive of p^3) 6.2.

"*Hab.* Oriente of Ecuador. Type from Gualaquiza; alt. 2500′.

"*Type.* Young adult male. B. M. No. 14.4.25.53. Original number 312. Collected 31st November, 1913, by Gilbert Hammond. Presented by Oldfield Thomas.

"This species is in colour quite like *M. napi,* which occurs in the same region, but is so much larger, as evidenced by its skull- and tooth-measurements, that it is clearly different. It is probably most nearly related to *M. rubricollis,* the species I have always regarded as *M. peruanus* Allen, but is distinguished from both by its much duller and less contrasted under surface" — Thomas, *l. c.*

Specimens examined, 0.

Remarks.— Not seen; description and comment from Thomas, given above in full.

Table I.—Measurements of Species and Subspecies of Microsciurus.

	External Measurements					Cranial Measurements					
	Numb. of specimens	Total length	Head and body	Tail	Hind foot	Numb. of specimens	Greatest length	Zygom. breadth	Interorb. breadth	Breadth of braincase	Length of nasals
M. alfari alfari	Type	250	145	105	36.5	Type	36	22	13	19	10
M. alfari venustulus	"	250	148	102	40	"	37	23.2	14	17.6	10.5
M. alfari browni	"	260	140	120	38	"	36	21.2	12.4	—	11
M. boquetensis	"	257	141	116	37	"	—	—	14	—	—
M. similis similis	5	250	127	121	33	4	35.4	20.5	13.4	17.7	10
M. similis fusculus	Type	234	126	108	35	None	—	—	—	—	—
M. simonsi	"	250	138	112	38	Type	38.8	23.5	—	—	—
M. otinus	"	242	130	112	36	"	—	22.7	13.3	—	10
M. isthmius isthmius	"	—	150	—	37	"	—	22	14.3	18	10
" " "	3	243	137	110	36	4	35.3	21.9	13.3	17.8	10.2
M. isthmius vivatus	Type	260	147	113	38	Type	38.2	22.5	13.4	18	10.7
" " "	2 top.	239	129	110	36	—	—	—	—	—	—
M. mimulus	Type	239	130	109	36	Type	38	23	13.5	—	10.6
" "	7	246	136	109	36	4	39.5	22.7	14	18.9	10.9
M. palmeri	8	270	149	120	40	4	37.8	21.7	13.4	18.1	10.7
M. peruanus	Type	240	130	110	38	Type	35	21.3	13	18	9
M. napi	"	—	157	—	37	"	—	21	13	—	9
M. rubrirostris	"	278	145	133	38	"	37	22	13.3	18.5	10
" "	1	310	160	150	40	1 top.	37	23	13.4	19	10
M. florenciæ	Type	270	150	120	40	Type	40	23.7	14	19	10
" "	3	273	143	130	40	3	38	22.8	13.8	18.8	10

Genus **Sciurillus** *Thomas.*

Sciurillus Thomas, Abstr. Proc. Zool. Soc. London, No. 133, p. 36, May 12, 1914; Proc. Zool. Soc. London, 1914, p. 416, June, 1914. *Cf.* also Thomas, Ann. and Mag. Nat. Hist. (8), XIII, p. 575, June, 1914 (incidental reference).

Type, *Sciurus pusillus* Desmarest; or, "should any doubt be thrown on the determination of *Sciurus pusillus,* the genus should be considered as founded on the species represented by the type of *S. kuhlii*" (Thomas, *l. c.*).

"Postorbital processes over posterior root of zygoma. Interorbital space as broad as the braincase. Zygomata very broad and strong. Anteorbital foramen small, far in front of the teeth, as in *Nannosciurus,* its opening continued upwards as a peculiar curved groove along the front edge of the anteorbital fossa.

"Cheek-teeth $\frac{5}{4}$, as in *Nannosciurus.* Molars low, as in other Nannosciurinæ, their set normal, as in *Nannosciurus,* the last molar not facing outwards as in *Myosciurus.* Their upstanding cusps, both above and below, very little developed. Their surface more smoothly basin-shaped, with less evident transverse ridges."

"As a genus, *Sciurillus* is very closely related to *Nannosciurus*, the reduction in the prominent transverse ridges of its molars, the peculiar structure of its anteorbital foramina, and its high but abruptly truncated ectopterygoids being its chief distinguishing characters. From *Myosciurus*, though both are undoubtedly of the same group, it is more widely separated" (Thomas, *l. c.*).

Sciurus pusillus, the Guiana pigmy squirrel, although well described and figured by Buffon in 1798, and first technically named from Buffon's specimen by Desmarest in 1817, has always been poorly represented in collections, and consequently very imperfectly known. Thomas first described its cranial characters in June, 1914, from the study of "a practically perfect skull," then recently received at the British Museum. "An examination of this skull," he says, "shows that instead of being in any way related to *Microsciurus* [to which genus it has of late years been referred] or other forms of American Sciurinæ, the Guianan Squirrel is a member of the Nannosciurinæ, in which it forms a special genus closely related to *Nannosciurus.*" As the Nannosciurinæ have heretofore been supposed to be "rigidly restricted to a small part of West Africa and to the Malay Archipelago," he adds: "The addition of Guiana to the known distribution of the group is therefore of extraordinary interest."

Sciurillus pusillus pusillus (*Desmarest*).

Le petit guerlinguet Buffon, Hist. nat., Suppl., VII, 1789, p. 263, pl. lxvi (Cayenne).

Sc[iurus] pusillus Desmarest (ex Geoffroy MS.), Nouv. Dict. d'Hist. nat. (nouv. éd.), X, 1817, p. 109 (based on Buffon, as above).

Macroxus pusillus Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 433, Dec. 1867 (Guiana).

Sciurus pusillus Alston, Proc. Zool. Soc. London, 1878, p. 670, pl. xli, part.— Allen, Bull. U. S. Geol. Survey (Hayden), IV, No. 4, pp. 887, 905, Dec. 11, 1878, part.

Microsciurus pusillus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 154, Feb. 26, 1914 (general account).

Macroxus kuhlii Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 443, Dec. 1867, "Brazil" (= probably Guiana).

S[ciurus] kuhlii (Gray) Nelson, Proc. Washington Acad. Sci., I, p. 32, May 9, 1899 (in text). Referred to *Microsciurus.*

Miscrosciurus kuhlii Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 162, Feb. 26, 1914 (description from Gray, and comment).

Type locality.— Cayenne.

Geographic distribution.— Cayenne (Buffon); Guiana (Gray).

In my paper on *Microsciurus* (*l. c.*), *Macroxus kuhlii* Gray was given provisionally as a species of *Microsciurus,* on the assumption that the type of *kuhlii* was obtained by Castelnau, as stated by Gray, and that it hence was probably collected on the Ucayali River during his journey across Peru. It was further suggested that such being the case the name *kuhlii* might have to replace my name *peruanus* for a species of *Microsciurus* from near the supposed type locality of *kuhlii.* Since this paper was published Thomas has stated that the type of *kuhlii* "is beyond question the '*Sciurus pusillus*' of Guiana, whence the type must have come — probably accidentally mixed with Castelnau material by the dealer (Parzudaki) from whom it was bought. The fact that the hind foot of the type of *kuhlii* is only 26 mm. in length would alone distinguish it from any of the Andean *Microsciuri.*" It is to be hoped that this decision by Thomas will give the troublesome name "*Macroxus kuhlii* Gray" a final resting place as a synonym of *Sciurillus pusillus.*

Sciurillus pusillus glaucinus *Thomas.*

Sciurillus pusillus glaucinus Thomas, Ann. and Mag. Nat. Hist. (8), XIII, p. 575, June, 1914.

Type locality.— Great Falls of Demerara River, British Guiana.

Geographic distribution.— Known only from the type locality.

Description.— "Like *S. pusillus* [*pusillus*], but much paler throughout.

"General colour above 'neutral grey' instead of greyish hair-brown. Under surface pale grey washed with light buffy, instead of dark grey washed with fulvous. Crown, muzzle, and inner side of ears pale grizzled buffy, many shades lighter than the almost ferruginous colour of *pusillus.* Back of ears and patches behind them prominently snowy white. Feet grizzled buffy. Tail-hairs tipped with whitish, a number of hairs in the terminal pencil black, a line along the centre below also black.

"Skull apparently rather smaller than in *pusillus,* but the type is not as old as the available examples of that animal.

"Dimensions of the type (measured on the skin): Head and body 104 mm.; tail, 113; hind foot, 27.7.

"Skull: Greatest length 27.5; condylo-incisive length 25; zygomatic breadth 20; nasals (on outer edge) 7 × 4.7; interorbital breadth 12.5; breadth of brain-case 15; palatilar length 10; upper tooth-series (exclusive of p^3) 3.8." — Thomas, *l. c.*

Specimens examined, 0.

Remarks.— Known to me only from Thomas's description, quoted above in full.

Genus **Leptosciurus** gen. nov.

Plate VII, Figs. 7–14; Plate XIII, Figs. 5–10; Text Figs. 2, 3 (p. 162).

Type, *Sciurus rufoniger* Pucheran = *Macroxus pucheranii* Fitzinger (to replace *rufoniger*, preoccupied).

Similar (in the typical phase) in external appearance to *Microsciurus*, but size larger and tail relatively longer and fuller (about 46% of total length instead of 40%). Mammæ, 6.

Premolars, $\frac{1}{1}$. Skull similar in general form and proportions to that of *Guerlinguetus æstuans*. Differs from *Guerlinguetus* in the structure of the upper molars, the outer border of the crowns having only two prominent cusps instead of three, and the intervening cusplets, usually prominent in *Guerlinguetus* and in most other American tree squirrels, are practically obsolete or entirely absent. The mammæ are also 6 instead of 8, and the tail is relatively shorter (about 46% of the total length instead of 50%).

Geographic distribution.— The Colombian Andes and parts of Peru and Bolivia. (See Map, p. 301.)

Remarks.— *Leptosciurus* is primarily based on the *Sciurus pucheranii* group, which in size, coloration, and texture of pelage greatly resembles the larger forms of *Microsciurus*. With it, on the basis of the tooth structure, number of mammæ, and relative length of the tail must be associated the *Sciurus ignitus* (= "*cuscinus*") group and Gray's *Macroxus leucogaster*, which latter differs from all the others in slightly larger size, different coloration, and coarser pelage.

List of Species and Subspecies, with their type localities, and statement of number of specimens examined.

Leptosciurus pucheranii pucheranii (Fitzinger). Bogotá, Colombia. Specimens examined, 8.

Leptosciurus pucheranii medellinensis (Gray). Medellin, Antioquia, Colombia. Specimens examined, 3.

Leptosciurus pucheranii caucensis (Nelson). Rio Lima, near San Antonio, Western Andes, Colombia. Specimens examined, 8.

Leptosciurus pucheranii salentensis (Allen). Salento, Central Andes, Colombia. Specimens examined, 14.

Leptosciurus ignius ignittus (Gray). Astillero, Bolivia. Specimens examined, 13.

Leptosciurus ignitus irroratus (Gray). Ocabamba, Peru. Specimens examined, 13.

Leptosciurus leucogaster Gray. Santa Cruz de la Sierra, Bolivia. Specimens examined, 7.

Key to the Species and Subspecies of Leptosciurus.

Smaller, average total length 300–350 mm.
  Tail fringed with white.
    Blackish dorsal line usually obsolete.
      Underparts brownish gray, the pectoral region faintly washed with buff. *pucheranii* (p. 200)
      Underparts brownish, strongly washed with ochraceous buff. *caucensis* (p. 203)
    Blackish dorsal line usually prominent.
      Underparts strongly washed with maize yellow. .*salentensis* (p. 203)
      Underparts washed with white. . . . .*medellinensis* (p. 201)
  Tail fringed with yellow.
      Underparts ochraceous buff. . . . .*ignitus* (p. 204)
      Underparts antimony yellow. . . . .*irroratus* (p. 206)
Larger, average total length about 385 mm., underparts white. .*leucogaster* (p. 207)

Leptosciurus pucheranii pucheranii (*Fitzinger*).

Text Fig. 2 (p. 162); Plate VII, Figs. 7, 8; Plate XIII, Figs. 5, 6.

Sciurus rufoniger Pucheran, Rev. zool., VIII, p. 336, Sept. 1845. Not *Sciurus rufoniger* of Gray 1842, nor of Allen 1877, nor of Alston 1878 (*cf.* this Bulletin, XXXIII, 1914, pp. 152, 153).

? *Sciurus chrysuros* Pucheran, Rev. zool., VIII, p. 337, Sept. 1845, "Santa-Fe de Bogata."

Funambulus pucheranii Fitzinger, Sitzb. d. math.-naturw. Cl., LV, Abth. 1, p. 487, 1867.

Macroxus tephrogaster Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 431, Dec. 1867, part (the Bogotá reference only).

Type locality.— Vicinity of Bogotá, Colombia.

Geographic distribution.— The Eastern Andes of Colombia, at altitudes of 6200 to 9000 feet.

Description.— Upperparts reddish brown, the hairs dusky at base tipped with ochraceous rufous; a blackish median band, varying from deep black to dusky, often nearly obsolete; nose and cheeks dull yellowish gray; underparts brownish gray faintly washed with pale yellow, brightest on the breast and paler on chin, throat, and abdomen; tail long and narrow, grizzled rufous and black, the hairs basally alternately ringed narrowly with rufous and black, with a broader subterminal bar of black and conspicuous white tips, forming a white edging; ears small but rather long and pointed, well haired, dark brown with a reddish tinge; upper surface of the feet nearly like the flanks.

Total length (5 specimens, collector's measurements), 312 (300–328) mm.; head and body, 165 (150–184); tail vertebræ, 145 (135–158); hind foot (with claws), 43 (41–45). Skull (2 adult topotypes), total length, 41, 42; zygomatic breadth, 24, 25; interorbital breadth, 13.8 (each); breadth of braincase, 20 (each); length of nasals, 11 (each); diastema, 9, 10; maxillary toothrow, 6.6, 7. (See also Table II, p. 208.)

Specimens examined, 13.— **Colombia**: Vicinity of Bogotá, 8 (Br. Mus., 6; Am. Mus. 2); Fusugasugá, 3; La Candela and Andalucia, each 1 (Am. Mus.).

Remarks.— *L. pucheranii pucheranii* was described by Pucheran in 1842, under the preoccupied name *Sciurus rufoniger*, and renamed *pucheranii* by Fitzinger in 1867. Its relationships have since been misinterpreted by various authors, owing to the defective original description, which made no reference to the dentition and gave no measurements, and to the absence of specimens from Bogotá for a long period that agreed with it. The validity of the species seems to have been recognized some years since by Thomas, as specimens received at the British Museum from the Bogotá district in 1899 are labelled *S. pucheranii*.

The specimens from Fusugasugá (6000 to 8000 ft.), a short distance southwest of Bogotá, agree very closely in size and coloration with those from Bogotá, and differ mainly from those of the Salento region in the paler coloration of the ventral surface. One specimen each from La Candela and Andalucia, near the southern end of the Eastern Andes, seem also to belong here.

In my recent paper on *Microsciurus* (*l. c.*, pp. 153, 158) I referred *Sciurus rufoniger* Pucheran to *Microsciurus*, and suggested its possible reference to *M. mimulus* Thomas, mainly on the basis of Alston's apparent representation that it had two upper premolars.[1] I have since been informed by Mr. Thomas (*in litt.*, Feb. 9, 1914) that all the squirrels from Bogotá that have been referred to *Microsciurus* are really members of the *pucheranii* group. As soon as I took up the *pucheranii* group for critical study I recognized that two specimens recently received at the American Museum from Bogotá, and others from nearby localities in the Eastern Andes, conformed perfectly with Pucheran's description of his *Sciurus rufoniger*.

Sciurus chrysuros Pucheran is not at present satisfactorily identifiable. It was described at the same time as *S. rufoniger*, it following that species on the same page, and as coming from the same locality,— "Habite la Colombie (Santa-Fe de Bogota)." It is described as being intermediate between "le Guerlinguet et l'Ecurcuil nain" (*Sciurus æstuans* and *S. pusillus* auct.), without the median dark band on the back of his *S. rufoniger*, and the tail "roux doré" instead of fringed with white. If the tips of the

[1] In 1878 Alston sent me one of the types of his (not Pucheran's) *Sciurus rufoniger*, on the label of which was written, "Compared with Pucheran's type in Paris Museum. E. R. A. April, 1878." (*Cf.* Allen, Bull. U. S. Geolog. Survey, IV, No. 4, p. 905, Dec. 11, 1878.)

hairs of the tail were worn, the tail of *rufoniger* would present this appearance. Alston appears to have compared the type of *chrysuros* with the type of *rufoniger* (both then in the Paris Museum) and says of them (Proc. Zool. Soc. London, 1878, p. 669): "The type of *S. rufoniger* has the middle of the back nearly black; while that of *M.* [= S.] *chrysurus* appears to be a variety, merely differing in the tail being more rufous." My present material supports Alston's opinion.

Leptosciurus pucheranii medellinensis (*Gray*).

Macroxus medellinensis Gray, Ann. and Mag. Nat. Hist. (4), X, p. 408, Nov. 1872.

Geographic distribution.— Known only from the vicinity of the type locality.

Description.— Similar above to *L. p. pucheranii;* ventral surface clear white superficially, the basal plumbeous portion of the pelage along the sides of the abdomen showing through. A Valdivia specimen has the ventral surface heavily washed with buff.

Total length (2 specimens, Valdivia, collector's measurements), 310, 310 mm.; head and body, 160, 170; tail vertebræ, 150, 140; hind foot (without claws), 39, 40; ear, 19, 18. No skull available at this writing.

Specimens examined, 3.— **Colombia**: Medellin, 1, topotype; Valdivia (near Medellin), 2 (all Br. Mus.). [See Addenda, p. 307.]

Remarks.— *L. pucheranii medellinensis* was originally described from 5 specimens from Medellin, two of which became the property of the British Museum, to which specimens from Valdivia have been since added. These I saw in April, 1913, but at this writing have only my notes to rely upon. Gray in describing the species compared it with his *Macroxus tephrogaster* (= *Sciurus deppei* Peters [1]), from Guatemala and Mexico, stating that it was "not above half the size of the more southern [northern] specimens," and that he was inclined to regard them "as a variety or species, under the name of *Macroxus medellinensis.*" He comments on the variability of the black dorsal band, which in one of the two specimens used in his description extended from the base of the neck to the tail, while the other had a very indistinct dorsal streak, with a squarish black spot on the middle of the back; in the former the white on the ventral surface was confined to "the middle of the throat, chest, and belly, the sides being grayish," while in the other the ventral surface was much whiter. A Valdivia specimen has the belly deep buff, showing that the usual wide range of individual variation in the color of the underparts obtains in this as in the other forms of the *pucheranii* group.

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[1] *Cf.* Nelson, Proc. Washington Acad. Sci., I, p. 103, May 9, 1899.

Leptosciurus pucheranii caucensis (*Nelson*).

Sciurus (*Guerlinguetus*) *caucensis* Nelson, Bull. Amer. Mus. Nat. Hist., XII, p. 79, April 14, 1899.

Sciurus medellinensis Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 366 (in text), Oct. 1900.

Type locality.— Rio Lima, near San Antonio, Western Andes, Colombia; altitude 6000 feet.

Geographic distribution.— Known only from the vicinity of the type locality.

Description.— Upperparts dark reddish brown, brightest on the outside of the shoulders and fore limbs, with an indistinct darkening along the middle of the back, quite different from the well-defined black median stripe of the northern forms, particularly *salentensis* and *pucheranii;* sides of the nose distinctly reddish instead of gray as in the other forms; underparts heavily washed with reddish buff, deepening on the breast to yellowish rufous; tail dark chestnut red grizzled with black and edged with white.

Total length (3 specimens, type and 2 topotypes, collector's measurements), 300 (288–313) mm.; head and body, 155 (140–160); tail vertebræ, 147 (144–148); hind foot (with claws), 43 (42–44). Skull (type and topotype), total length, 40.8 (40.6, 41); zygomatic breadth, 23.8 (23.5, 24); interorbital breadth, 13.9 (13.8, 14); breadth of braincase, 19.9 (19.8, 20); length of nasals, 11 (11, 11); diastema, 9.5 (9, 10); maxillary toothrow, 6.8 (6.8, 6.8).

Specimens examined, 8.— **Colombia**: Rio Lima, 4, type and topotype (Am. Mus.) and 2 topotypes (Br. Mus.); Parvas, Western Andes, 4 (Br. Mus.).

Remarks.— In *L. pucheranii caucensis* the upperparts are more strongly suffused with red than in any of the other forms of the group, especially the fore limbs and the sides of the nose, while the underparts are much deeper yellow, approaching orange yellow on the breast.

In 1900 this subspecies was referred by Thomas (*l. c.*) to Gray's *medellinensis,* but these two forms prove to represent the two most diverse phases of the group, especially in respect to the coloration of the ventral surface.

Leptosciurus pucheranii salentensis (*Allen*).

Guerlinguetus pucheranii salentensis Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 587, Sept. 8, 1914.

Type locality.— Near Salento, Central Andes, Colombia; altitude 9000 feet.

Geographic Distribution.— Central Andes, from the Salento district (near Quindio Pass), south to Miraflores, at altitudes of 6000 to 9000 feet.

Description.— Upperparts with a broad median dusky band, sparingly punctated with ochraceous, the rest of the upperparts with the hairs broadly tipped with bright ochraceous; underparts nearly uniform pale yellow; tail as usual in the group, blackish above washed with white, below grizzled ochraceous and black edged with white.

Total length (type, collector's measurements), 312 mm.; head and body, 163, tail vertebræ, 143; hind foot, 40. Six adult specimens, Salento and a little above Salento (7000–9000 feet): Total length, 300.5 (288–312); head and body, 158 (149–163); tail vertebræ, (135–150); hind foot, 41.7 (40–45).

Skull (type), total length, 42; zygomatic breadth, 24; postorbital breadth, 12.4; breadth of braincase, 20; length of nasals, 11; maxillary toothrow, 6.8.

Specimens examined, 14.— **Colombia**, western slope of Central Andes: Salento and vicinity, 7; El Roble, 2; Laguneta, 2; Miraflores, 2; Palmira, 1 (all Am. Mus.). [See Addenda, p. 307.]

Remarks.— In three specimens the dorsal band is black, broad, and sharply defined; in two it is obsolete; in all the others it is merely a darkening of the median line, the hairs being lightly tipped with ochraceous. The two specimens from Miraflores (alt. 6200 ft.) and the single specimen from Palmira very closely resemble those from La Guneta (alt. 10,300 ft.), El Roble, and part of the Salento specimens; one, however, from above Salento (alt. 9000 ft.) and one from Salento differ from the others in being nearly white below with only a faint yellowish wash.

Leptosciurus ignitus ignitus (*Gray*).

Macroxus ignitus Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 429, Dec. 1867. "Bolivia (Brydges)."

Sciurus cuscinus Thomas, Ann. and Mag. Nat. Hist. (7), IX, p. 129, Feb. 1902, part. (Charuplaya, Bolivia, alt. 1350 m.).

Sciurus cuscinus ochrescens Thomas, Ann. and Mag. Nat. Hist. (8), XIII, p. 362, March, 1914 (Astillero, Bolivia, alt. 2700 mm.).

Type locality.— "Bolivia" — probably near Yungas, upper Rio Beni, which may be regarded as the type locality.

Geographic distribution.— Bolivian Andes, at altitudes of about 3500 to 9000 feet.

Description.— Pelage soft, of medium length and fulness. Mammæ 6. Upperparts olive, the hairs minutely tipped with yellow; underparts varying (in different specimens from the same locality) from light yellow to deep yellow, a little lighter on throat and chin than on the belly; tail above, at the extreme base, like the back, rest of the upper surface blackish, the hairs with long reddish yellow tips often nearly concealing the darker basal portions; under surface of tail grizzled orange and black medially, with a broad subterminal band of black strongly edged outwardly with reddish yellow or orange; ears reddish yellow with bright orange postauricular patches; upper surface of feet finely grizzled orange and black, the toes in some specimens becoming clear orange yellow, in others not different from the proximal portion of the foot.

Ten adult specimens (7 females, 3 males), from Astillero, San Carlos, San Ernesto, Yungas, and Charumplaya, Bolivia (long. 65°–68°, lat. 15°–16°), collected and measured by P. O. Simons: Total length, 355 (342–370); head and body, 180 (160–198); tail vertebræ, 178 (160–180); hind foot (s. u.). 46.6 (45.48). (See also Table II, p. 208.)

Specimens examined, 13.— **Bolivia**: Astillero, 3 (type and 2 topotypes); Charumplaya, 2; San Carlos, 2; San Ernesto, 3; Yungas, 3 (all in Br. Mus., except 1 of the Yungas specimens, which is in Am. Mus.).

Remarks.— *Sciurus cuscinus ochrescens* has been described since my examination of the "*cuscinus*" material in the British Museum. At that time I was strongly impressed with the wide range of color variation shown in series of specimens from the same locality, and was rather surprised when I received the description of "*ochrescens*", based on the Bolivian specimens. It being impracticable for me to reëxamine the *cuscinus* group material, I provisionally accept *ochrescens* (=*ignitus*), moved partly to this decision by Thomas's opinion and partly by the geographical probabilities of the case. The "*cuscinus*" group, as now known, occupies an oval area of considerable geographical extent in the Peru-Bolivia Andes, with its major axis running in a northwest-southeast direction, from west longitude 65° at the south to 72° at the north (approximately 500 miles), and between 12° and 16° south latitude (approximately 300 miles). The type localities of *cuscinus* and *ochrescens* are, respectively, as are those of *irroratus* and *ignitus*, at the extreme northwestern and extreme southeastern borders of this area, and therefore widely separated in a region of considerable physiographic diversity, yet the two forms are only slightly differentiated.

In this connection two questions of nomenclature require consideration. In 1867, Gray described two species that evidently belong to the "*cuscinus*" group, both from localities not definitely indicated, namely, *Macroxus irroratus*, from Peru, collected by E. Bartlett on the "Upper Ucayali"; and *Macroxus ignitus*, from "Bolivia (Brydges)," probably on the Upper Rio Beni. *M. ignitus* precedes by two pages the name *irroratus*, both names having been published in the same paper, and the former will be first considered.

Some twenty years ago (hence before *cuscinus* was described), I identified a single specimen of squirrel from Yungas, Bolivia, as *ignitus* Gray, and a restudy of this specimen, in connection with considerable "*cuscinus*" material, leads me to believe that this determination was correct. The type locality of *ignitus* was within the present known range of *ochrescens,* and not the Sta. Cruz de la Sierra region, where the well-known collector Steinbach has found Gray's *Macroxus leucogaster* but no squirrels of the *cuscinus* group. This being the case, and there being nothing contra-indicative in the description, *Macroxus ignitus* is apparently the earliest name for any member of the *cuscinus* group.

Macroxus irroratus as clearly belongs also to the *cuscinus* group. This was recognized by Thomas when, in 1897, he described *cuscinus,* but owing to certain slight discrepancies between the description of *irroratus* and his type of *cuscinus,* he decided to hold the name *irroratus* in abeyance. In view of the now known wide range of individual variation in undoubted *cuscinus* specimens, the supposed importance of these discrepancies practically disappears.

Both *ignitus* and *irroratus* are very unlike any other squirrels, although both have been referred to "*æstuans,*" as *æstuans* was formerly understood. They are nearest in size and tooth structure to Gray's *Macroxus leucogaster,* but the original descriptions forbid their reference to this species. No other small squirrel (except species of *Microsciurus*) is known to occur nearer than 500 miles of the range of the *ignitus-irroratus* ("*cuscinus*") group, namely the Ecuador forms of *hoffmanni* of the genus *Mesosciurus.* Its range is thus widely separated from that of any other with which it has any near alliance.

Leptosciurus ignitus irroratus (*Gray*).

Text Fig. 3 (p. 162); Plate VII, Figs. 10–12; Plate XIII, Figs. 7, 8.

Sciurus æstuans Tschudi (not of Linné), Fauna Peruana, I, Therologie, 1844–46, p. 158, part.

Macroxus irroratus Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 431, Dec. 1867 (Upper Ucayali River, Peru).

Sciurus æstuans cuscinus Thomas, Ann. and Mag. Nat. Hist. (7), III, p. 40, Jan. 1899 (Ocabamba, Peru); *ibid.*, VII, p. 187, Feb. 1901 (Rio Inambari).— Allen, Bull. Amer. Mus. Nat. Hist., XIII, p. 226, Nov. 16, 1900; *ibid.*, XIV, p. 46, Jan. 31, 1901 (Inca Mines, near Juliaca, Peru).

Type locality.— Upper Rio Ucayali, Peru.

Geographic distribution.— Andes of southeastern Peru.

Description.— Similar to *ignitus* in size and general coloration, but color of underparts rather paler.

Four adult specimens, all females, from Inca Mines (lat. 13° 30′ S., long. 70°, alt. 6000 ft.) collected and measured by H. H. Keays: Total length 349.5 (343–356); head and body, 184 (178–197); tail vertebræ, 165 (159–178); hind foot (s. u.), 45.2 (44.5–47.6).

Four skulls from Inca Mines, Peru, occipito-nasal length, 45.5 (44.5–46); zygomatic breadth, 26.5 (26–27); interorbital breadth, 14.5 (13–15); breadth, of braincase, 20.9 (20.5–21); length of nasals, 12.6 (12–13.3); diastema, 11.2 (10.2–11.5); upper molar series, 6.9 (6.5–7).

Specimens examined, 13.— **Peru**: Ocabamba, 2, type and topotype of *cuscinus;* Rio Yimimpare, 2; Maracapata, 3; Pachita, 1; Inca Mines (Carabaya Range), 5 (all in Brit. Mus. except the Inca Mines specimens, which are in Am. Mus.).

Remarks.— As already noted, the type locality of *irroratus* was the upper Rio Ucayali. Its range occupies, as stated by Thomas (for his "*cuscinus*"), the region drained by the upper Ucayali and Madre de Dios Rivers. *Sciurus cuscinus* was originally described from two specimens from Ocabamba, Province of Cuzco, Peru, collected by Otto Garlepp in 1897, and from whom were later received (in 1903) at the British Museum six other specimens from nearby localities. In 1900 five specimens were received at the American Museum from Inca Mines, Carabaya Range, Peru, collected by H. H. Keays. All are from the Andean region of southeastern Peru, at 6000 to 8000 feet altitude.

Leptosciurus leucogaster (*Gray*).

Plate VII, Figs. 13, 14; Plate XIII, Figs. 9, 10.

Macroxus leucogaster Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 430, Dec. 1867. Not *Sciurus leucogaster* F. Cuvier, 1831 = *S. aureogaster* F. Cuvier, 1829.

Type locality.— Santa Cruz de la Sierra, Bolivia; coll. Bridges.

Geographic distribution.— Provinces of Santa Cruz de la Sierra and del Sara, eastern Bolivia, and westward into La Paz Province.

Description.— Pelage short and thin. Mammæ 6. Upperparts olive, minutely punctated with yellow; eyerings and sides of nose pale buff; underparts white nearly or quite to the base of the hairs, varying in different individuals; tail broad, above like the back, edged with pale yellow; under surface of tail grizzled black and pale buff medially, the hairs with a broad subterminal band of black and pale yellow tips; ears long, pointed, yellowish brown externally, rusty yellow internally, with a buffy yellow postauricular

Table II.—Measurement of Species and Subspecies of Leptosciurus.

		External Measurements					Cranial Measurements							
		Number of specimens	Total length	Head and body	Tail vertebræ	Hind foot	Number of specimens	Total length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of nasals	Diastema	Maxillary toothrow
pucheranii	Aver.	5	312	165	145	43^{c}	2	41.5	24.5	13.8	20	11	9.5	6.8
Near Bogotá	Min.		300	150	135	41		41	24	13.8	20	11	9	6.6
O'Connell and Gonzales	Max.		328	184	158	45		42	25	13.8	20	11	10	7
salentensis	Aver.	6	300	153	143	42^{c}	4	41.4	23.9	13.7	19.7	11.7	—	6.7
Salento, Col.	Min.		288	148	135	40		41	23.7	12.5	19.4	11.3	—	6.5
L. E. Miller	Max.		310	163	150	45		42	24	14.6	20	12	—	7
caucensis	Aver.	3	300	155	147	43^{c}	3	40.8	23.8	13.9	19.9	11	9.5	6.8
Upper Rio Cauca, Col.	Min.		288	140	144	42		40.6	23.5	13.8	19.8	11	9	6.8
J. H. Batty	Max.		315	160	148	44		41	24	14	20	11	10	6.8
medellinensis	Aver.	2	310	165	145	$39^{s}.5$	0							
Medellin, Col.	Min.		310	160	150	39								
British Museum	Max.		310	170	140	40								
irroratus	Aver.	4	349	184	165	$45^{s}.2$	4	44.5	26.5	14.5	20.9	12.6	11.2	6.9
Inca Mines, Peru	Min.		343	178	159	44.5		44.5	26	13	20.5	12	10.2	6.5
H. H. Keays	Max.		356	197	178	47.6		46	27	15	21	13.3	11.5	7
ignitus	Aver.	10	355	180	178	$46^{s}.6$	1	48	26.7	15.3	22	14	11.5	7
Bolivian Andes	Min.		342	160	160	45								
P. O. Simons	Max.		370	198	180	48								
leucogaster	Aver.	2	385	200	185	$48^{c}.5$	1	48	28	15.3	21	14	12	8
Santa Cruz de la Sierra, Bolivia	Min.		380	200	180	48								
T. Steinbach	Max.		390	200	190	49								

patch in winter pelage, obsolete or absent in summer pelage; upper surface of feet colored like rest of upperparts.

Total length (2 adult males, collector's measurements), 390, 380 mm.; head and body, 200, 200; tail vertebræ, 190, 180; hind foot (in dry skin, with claws), 49, 48; ear, 23, 23.

Skull, adult female (Prov. del Sara, Bolivia), occipito-nasal length, 48; zygomatic breadth, 28; interorbital breadth, 15.3; postorbital breadth, 17; breadth of braincase, 21; length of nasals, 14; diastema, 12; maxillary toothrow, 8.

Specimens examined, 7.— **Bolivia**: Santa Cruz de la Sierra, 2 "cotypes" (Br. Mus.); Chulumani, La Paz, 1 (Br. Mus.); Central Bolivia, 1 (Br. Mus.); Santa Cruz de la Sierra, 1, topotype (Pittsb. Mus.); Province del Sara, 1 (Pittsb. Mus.); Rio Mapaiso, Rio Grande, 1 (Pittsb. Mus.). Five of the specimens were collected by T. Steinbach, the two cotypes by Bridges. On Steinbach's label on the specimen from Rio Mapaiso is written: "The only specimen seen south of Santa Cruz."

Remarks.— *Leptosciurus leucogaster* is similar to *L. ignitus* but paler above throughout, with the belly white instead of deep yellow, and much larger in all external measurements. Gray's specific name *leucogaster* (*Macroxus leucogaster*) is available in the present connection, as the species is not a *Sciurus* in a strict sense, and the name therefore not preoccupied by the earlier *Sciurus leucogaster* of F. Cuvier.

Genus **Notosciurus** *Allen.*

Plate IX, Figs. 1–3; Text Figs. 4 (p. 162), 20, 21.

Notosciurus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 585, Oct. 8, 1914.

Type, *Notosciurus rhoadsi* Allen.

Size small, tail of medium length, the tail vertebræ 46% of total length; naked part of plantar surface of hind feet restricted to distal half, the rest heavily furred; posterior pad large and nearly square, occupying the whole breadth of the sole, close to the toe pads; number of mammæ not known, but probably 6.

Premolars $\frac{1}{1}$ (?).[1] Skull in general form much like that of *Guerlinguetus æstuans,* but the preorbital portion is relatively much shorter, and the breadth at the anterior end of the zygomata much less, the zygomatic arches

[1] The single known skull is young, still retaining the milk premolar (p^4), so that it is impossible to say whether or not the permanent dentition might include p^3.

being strongly instead of moderately convergent anteriorly; ratio of breadth of skull at m[1] 49% of the total length instead of 57% as in *æstuans*, or 53% as in *hoffmanni;* malar of nearly even width, and nearly straight instead of having a well developed superior process and a marked depression behind it; molars and other cranial features nearly as in *æstuans.* (As the type skull is somewhat immature, allowance is made for slight change in form through growth.)

Geographic distribution.— Known only from the type locality of the single known species.

Remarks.— The distinctive feature of the present genus is the striking character of the plantar surface of the hind feet, which renders it at once distinguishable from all other genera. The very short rostrum, the narrowness of the skull at the front border of the orbits and the form of the malar bone serve to distinguish it also from *Leptosciurus, Guerlinguetus,* and *Mesosciurus.*

Notosciurus rhoadsi *Allen.*

Sciurus irroratus Stone, Proc. Acad. Nat. Sci. Philadelphia, 1914, p. 14 (not of Gray).

Notosciurus rhoadsi Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 585, Oct. 8, 1914.

Type locality.— Pagma Forest, Chunchi, Ecuador; altitude 6300 feet.

Geographic distribution.— Known only from the type locality.

Description.— "Character of the pelage and coloration nearly as in *Guerlinguetus hoffmanni,* but ears relatively long and narrow, and the proximal half of the soles of the hind feet heavily furred.

"Upperparts uniformly finely grizzled pale yellow and dusky, the hairs individually blackish basally and narrowly ringed near the tip with pale yellow and black, mixed sparingly with hairs wholly black, resulting in a pale yellowish brown general effect; underparts ochraceous orange, paler on the chin, throat and sides of nose; limbs externally like the upperparts, and internally like the belly, the feet grizzled with pale orange; ears rufous, well haired on both surfaces; tail grizzled on both surfaces like the back, the tips of the hairs pale orange, the hairs individually narrowly ringed alternately with yellowish buff and black, the undersurface of the tail with a submarginal, rather narrow band of black and long ochraceous tips.

"Total length (collector's measurements), 330 mm.; tail vertebræ, 152; hind foot, 50; ear, 20.

"Skull, total length 47; zygomatic breadth, 27; interorbital breadth, 15; postorbital breadth, 13; breadth of braincase, 22.5; nasals, 14 × 7; diastema, 11; maxillary toothrow, 8. The skull still retains the milk premolars, and therefore the specimen is not fully adult, although it has the appearance of being adult in all other respects."— Allen, *l. c.*

Specimens examined, 1.— Known only from the type, in the Museum of the Philadelphia Academy of Natural Sciences.

Remarks.— The general appearance of *Notosciurus rhoadsi* is that of a

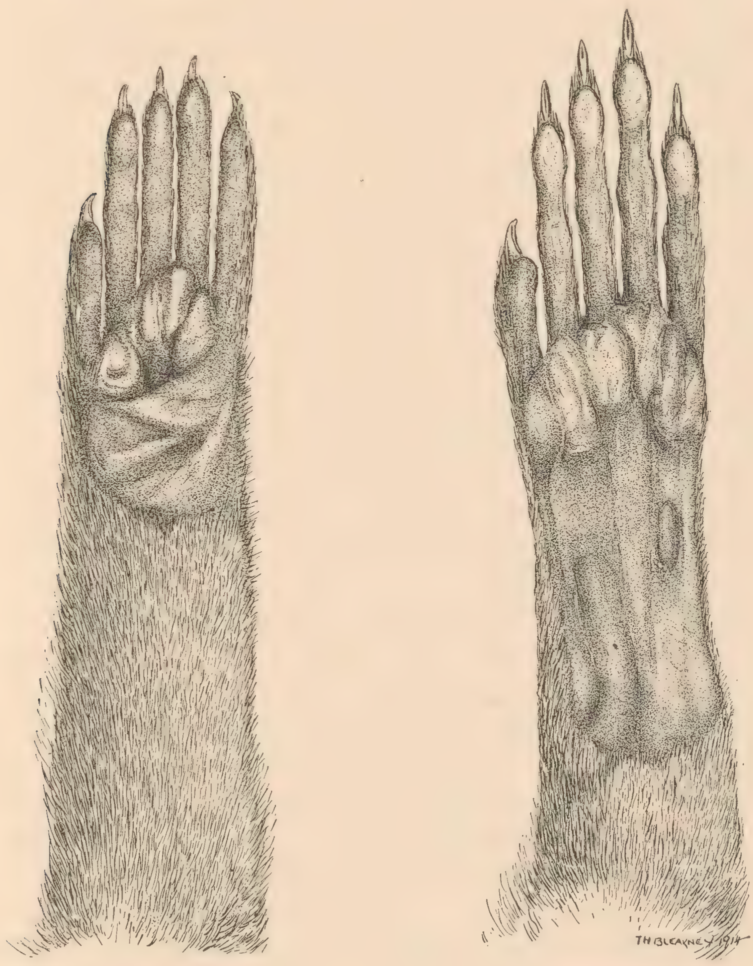

Fig. 20. Fig. 21.

Fig. 20. Hind foot of *Notosciurus rhoadsi*. $\frac{2}{1}$.

Fig. 21. Hind foot of *Mesosciurus hoffmanni hoffmanni* (Peters), for comparison with Fig. 20. $\frac{2}{1}$.

pale *hoffmanni* in miniature, in bulk *N. rhoadsi* being less than half the size of *hoffmanni*. The generic characters render it distinguishable at sight, particularly the structure of the hind foot.

Genus **Mesosciurus** gen. nov.

Plate VIII, Figs. 1–10; Plate XIII, Figs. 11–18, Text Figs. 5, 6, 14 (pp. 162–165).

Type, *Sciurus æstuans* var. *hoffmanni* Peters.

Size medium to above medium, much larger than in either *Leptosciurus* or *Guerlinguetus;* mammæ, 6, instead of 8 as in *Guerlinguetus;* tail about 47 to 48% of total length; character of pelage strongly variable, in correlation with the environment.

Premolars, $\frac{1}{1}$. Cranial and dental characters nearly as in *Guerlinguetus,* but rostral portion of skull longer, interorbital area slightly narrower, and zygomata laterally more convex, giving a slightly higher ratio of zygomatic breadth to total length. M^1 and m^2 are nearly as in typical *Sciurus;* m^3 has usually two subequal prominent anterior cusps (parastyle and mesostyle) on the outer border, but in some forms the mesostyle is decidedly larger than the parastyle; p^4 is usually quite similar in form and details of crown surface to the same tooth in *Sciurus.*

Geographic distribution.— Northern South America, north and west of the Orinoco and Amazon main drainage areas, from southern Ecuador north to Costa Rica and Nicaragua, except southern Panama and northwestern Colombia. (See Map, p. 299.)

Remarks.— *Mesosciurus* is the middle form among South American tree squirrels, in respect to both size and general details of structure, especially with respect to dentition. It includes three quite well marked groups, distinguishable by size, character of pelage, style of coloration, and geographic distribution. The first (subgenus **Mesosciurus**), the *hoffmanni* group (including *Sciurus richmondi* of Nicaragua), is very numerous in forms (6 species and 6 subspecies), and is restricted to the Andean region from about the northern border of Peru into Central America, and the northern part of Venezuela. It is usually not represented near sea level, although sea level forms have been developed on the coast of Ecuador and in Venezuela, Panama, Costa Rica, and Nicaragua. The usual altitudinal range is the subtropical and temperate zones, where it reaches altitudes of 8,000 to 10,000 feet. In the Central and Eastern Andes typical *hoffmanni* develops various local forms, through which, to the eastward, it appears almost to intergrade with the *griseogena* group, from which *chapmani* of northeastern Venezuela and Trinidad is not strongly different, and from which the insular forms of the group have been differentiated. Typical *hoffmanni* presents a remarkable hiatus in distribution in northwestern Colombia and the southern part of Panama, where as yet no specimens have been collected, although it seems impossible to separate subspecifically central Costa Rica specimens from those of the Western Andes in Colombia.

A second group (subgenus **Histriosciurus** [1]) is the *gerrardi* group, consisting of a considerable number of exceedingly variable forms (1 species with 7 subspecies) the most diverse of which, in their extreme phases, are strikingly unlike in coloration, and vary *inter se* to some extent in size and cranial characters. In proportions of parts and in cranial characters they are quite similar to the *hoffmanni* section of the genus. The *gerrardi* forms are practically restricted to the tropical zone, and occupy the low lands of northern and western Colombia from the Venezuela boundary to the Canal Zone in Panama, and range thence southward along the coast of Colombia to northeastern Ecuador. So far as now known the ranges of the *gerrardi* and *hoffmanni* groups do not overlap.

The third group (subgenerically referable to *Histriosciurus*) consists of 2 species and 2 subspecies, the *saltuensis* group of the Santa Marta district of northeastern Colombia and *pyrrhinus* of Peru. The known forms of this group are similar in size to the forms of the *gerrardi* group, but do not closely resemble them in coloration, but in other respects are nearly related. The *saltuensis* group is white-bellied, while the *gerrardi* group is red-bellied. Although not formerly known to occur outside of the Santa Marta district, it has recently been found to reach the lower Cauca valley, while an allied form (*Sciurus pyrrhinus* Thomas) is known from Peru. This may be either white-bellied or red-bellied, at the same localities.

List of Species and Subspecies, with their type localities, and statement of number of specimens examined.

Mesosciurus hoffmanni hoffmanni (Peters). "Costa Rica"; here designated as San José, Costa Rica. Specimens examined, 87.

Mesosciurus hoffmanni chiriquensis (Bangs). Divala, Chiriqui, Panama. Specimens examined, 90.

Mesosciurus hoffmanni manavi (Allen). Manavi, Rio de Oro, Ecuador. Specimens examined, 12.

Mesosciurus hoffmanni quindianus (Allen). Rio Frio, Central Andes, Colombia. Specimens examined, 15.

Mesosciurus hoffmanni hyporrhodus (Gray). Santa Fé de Bogotá, Colombia. Specimens examined, 23.

Mesosciurus griseogena griseogena (Gray). "Venezuela" (apud Thomas). Specimens examined, 39.

[1] Type, *Sciurus gerrardi* Gray.

Mesosciurus griseogena meridensis (Thomas). Escorial, Sierra de Merida, Venezuela. Specimens examined, 57.

Mesosciurus chapmani (Allen). Island of Trinidad. Specimens examined, 35.

Mesosciurus chapmani tobagensis (Osgood). Island of Tobago. Specimens examined, 7.

Mesosciurus nesœus (G. M. Allen). Margarita Island, Venezuela. Specimens examined, 3.

Mesosciurus griseimembra (Allen). Buenavista, about 50 miles southeast of Bogotá, Colombia. Specimens examined, 5.

Mesosciurus candalensis (Allen). La Candela, near San Agustin, Huila, Colombia. Specimens examined, 11.

Mesosciurus gerrardi gerrardi (Gray). "New Grenada"; probably near Medellin. Specimens examined, 18.

Mesosciurus gerrardi milleri (Allen). Cocal, Western Andes, Colombia. Specimens examined, 14.

Mesosciurus gerrardi versicolor (Thomas). Cachavi, Esmeraldas, Ecuador. Specimens examined, 16.

Mesosciurus gerrardi morulus (Bangs). Loma del Leon, Panama. Specimens examined, 26.

Mesosciurus gerrardi choco (Goldman). Cana, eastern Panama. Specimens examined, 28.

Mesosciurus gerrardi salaquensis (Allen). Rio Salaqui, northwestern Colombia. Specimens examined, 7.

Mesosciurus gerrardi zuliæ (Osgood). Orope, Zulia, Venezuela. Specimens examined, 8.

Mesosciurus gerrardi cucutæ (Allen). El Guayabal, near San José de Cucuta, Colombia. Specimens examined, 5.

Mesosciurus saltuensis saltuensis (Bangs). Pueblo Viejo, Santa Marta, Colombia; altitude, 8000 feet. Specimens examined, 27.

Mesosciurus saltuensis bondæ (Allen). Bonda, Santa Marta, Colombia; altitude 200 feet. Specimens examined, 60.

Mesosciurus saltuensis magdalenæ (Allen). Banco, Rio Magdalena, near mouth of Rio Cesar, Colombia. Specimens examined, 2.

Mesosciurus pyrrhinus (Thomas). Garita del Sol, Vitoc, Peru. Specimens examined, 9.

Key to the Species and Subspecies of Mesosciurus.

Size small; average total length 375–410 mm.; underparts red. Subgenus *Mesosciurus*.

Tail without a distinctly black tip.

Upperparts yellowish brown to rufescent brown; underparts dull yellow to orange red.
Size medium.
Pelage soft and thick........................*hoffmanni* (p. 216)
Pelage harsher and thinner..................*chiriquensis* (p. 220)
Similar but underparts redder and tail with more black at base below.
manavi (p. 221)
Size smaller.
Similar in coloration to *hoffmanni*..............*chapmani* (p. 330)
Like *chapmani* but smaller.....................*tobagensis* (p. 232)
Size larger; tip of tail blackish.
With (usually) a dorsal black band..........*quindianus* (p. 222)
Without (usually) a dorsal black band.........*hyporrhodus* (p. 223)
Upperparts darker and more olivaceous; underparts whitish, fulvous gray, or deep red.
Inside of limbs dark gray...................*griseimembra* (p. 233)
Inside of limbs fulvous.........................*candalensis* (p. 235)
Upperparts, including tail, light ochraceous; below bright orange rufous.
nesœus (p. 233)
Tail red, the tip black for the terminal 50 mm.
Pelage rather short and thin....................*griseogena* (p. 226)
Pelage long and full........................*meridensis* (p. 228)
Size medium; average total length 430–460 mm.; underparts red in *gerrardi* group, white in *saltuensis* group. Subgenus *Histriosciurus*.
Upperparts with a broad black median band from shoulders to base of tail.
Tail black at base, rest red, without black at tip of tail.
Fore limbs, shoulders, flanks, and hind limbs red..*gerrardi* (p. 236)
Fore limbs, shoulders, flanks, and hind limbs ochraceous.
salaquensis (p. 245)
Tail blackish at base, and with more or less black at tip.
Similar in general coloration to *gerrardi*........*versicolor* (p. 242)
Upperparts dark chestnut, blackish mesially, and feet blackish; base of tail below and anal area black..............*milleri* (p. 241)
Tail with the tip wholly black.
Median dorsal band obsolete; shoulders, flanks, and feet not red.
morulus (p. 243)
Median dorsal band narrow; in general coloration similar to *morulus*.
choco (p. 244)
Tail with the apical fourth or third intense black; fore limbs and feet, flanks, thighs, and hind feet deep red or reddish....*zuliæ* (p. 246)
Similar to *zuliæ* but much paler throughout........*cucutæ* (p. 247)
Upperparts red; underparts white.
Pelage long and soft.
Upperparts light yellowish red, usually strongly grizzled with black on the back...............................*saltuensis* (p. 247)
Lighter colored and less strongly grizzled with black..*bondæ* (p. 249)
Pelage short and hispid.
Upperparts dark red........................*magdalenæ* (p. 251)
Upperparts dark red; tail banded with black; underparts white or red, or mixed white and red.................................*pyrrhinus* (p. 252)

Subgenus **Mesosciurus.**

Mesosciurus hoffmanni hoffmanni (*Peters*).

Text Fig. 5 (p. 162); Plate VIII, Figs. 1–3; Plate XIII, Figs. 11, 12.

Sciurus æstuans var. *hoffmanni* Peters, Monatsb. Akad. Wissen. Berlin, 1863 (1864), p. 654 (Costa Rica).— Thomas, Proc. Zool. Soc. London, 1880, p. 401 (in text), part.

Sciurus æstuans hoffmanni Allen, Bull. Amer. Mus. Nat. Hist., III, p. 206, April 17, 1891; *ibid.*, IX, p. 35, March 11, 1897 (Costa Rica).— Nelson, Proc. Washington Acad. Sci., I, p. 98, pl. i, fig. 7, May 9, 1899 (Costa Rica to valley of Upper Rio Cauca).

Sciurus hoffmanni Allen, Bull. U. S. Geol. Surv. Terr. (Hayden), IV, No. 4, p. 885, Dec. 11, 1878 (considered distinct from *S. æstuans*); Bull. Amer. Mus. Nat. Hist., XXXI, p. 90, April 19, 1912 (Cauca, Colombia).—Lönnberg, Ark. för Zool., VIII, No. 16, p. 25, July 12, 1913 (Nanegal and Gualea, Ecuador).

Sciurus (*Guerlinguetus*) *hoffmanni* Allen, Bull. Amer. Mus. Nat. Hist., XX, pp. 44, 66, Feb. 29, 1904, part, (Costa Rica; Chiriqui, Panama; Cauca Valley, Colombia). *Sciurus* (*Guerlinguetus*) *æstuans chiriquensis* Bangs referred to *hoffmanni* at p. 66.

Sciurus æstuans var. *rufoniger* Allen, Mon. N. Amer. Rodentia, p. 757, 1877, part (Costa Rica references only. Not of Gray 1842, nor of Pucheran 1845).

Sciurus æstuans Alston, Biol. Cent.-Amer., Mamm., p. 132, pl. xiii, June, 1880, part (*Sciurus griseogenys* on plate).— Thomas, Proc. Zool. Soc. London, 1880, p. 400 (Intac and Balzar Mts., Ecuador).

Macroxus xanthotus Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 429, Dec. 1867 (Costa Rica. Type examined).

Sciurus griseogenys Alston, Proc. Zool. Soc. London, 1878, p. 667, part; Biol. Centr.-Amer., Mamm., pl. xiii, June, 1880.

Sciurus hoffmanni söderströmi Stone, Proc. Acad. Nat. Sci. Philadelphia, LXVI, p. 14, March 31, 1914 ("Mt. Pichincha"). Type examined.

Type locality.— "Costa Rica"; no definite locality indicated. The type region is here assumed to be the vicinity of San José, at altitudes above 3000 feet (see p. 218).

Geographic distribution.— Costa Rica and the Western Andes of Colombia, south through central Ecuador to Bolivia; not known to occur in southern Panama, nor in the lowlands of northwestern Colombia.

Description.— Pelage of medium length and softness. Postauricular patches present but usually not conspicuous.

Upperparts pale yellowish brown to rufescent brown, the hairs dark brown narrowly ringed at the tip with pale yellow varying (in different specimens) to rusty yellow; middle of the back often a little darker than the sides, sometimes a distinctly darker median band; outer surface of legs and feet nearly like the flanks; a narrow yellowish eyering; underparts orange yellow, varying in different specimens from dull yellow to orange red; chin and throat fulvous gray, paler than the rest of the ventral surface; tail at base, both above and below, like the back; rest of the upper surface of tail with the hairs at base annulated with buffy gray and black, followed by a broad zone of black and broadly tipped with orange, varying in different specimens from pale orange to orange red; tail below with the middle area grizzled yellowish brown and black, the sides and tip broadly edged with the same shades of orange or red as the upper surface; tail tipped normally with orange with the subapical black zone showing through the surface color,— not normally tipped with black as in *griseogena*. Ears rather long and pointed, dusky or blackish on the apical third posteriorly, and fulvous or rusty buff at the base, the basal hairs soft and somewhat elongated, forming a more or less pronounced postauricular patch, varying in prominence with the condition of the pelage in respect to season and wear.

Total length (6 specimens, Volcán de Irazú, Costa Rica), 391 (375–420); head and body, 208 (202–217); tail vertebræ, 199 (167–215); hind foot, 54.5 (52–55).

Skull (6 specimens, Volcán de Irazú, Costa Rica), total length, 51.8 (50.3–53); zygomatic breadth, 30.7 (29.8–32); interorbital breadth, 16.3 (15–17); breadth of braincase, 23.7 (23–24); length of nasals, 15.5 (14.2–16.2); maxillary toothrow, 8.5 (8–9).

(For measurements of additional series of *hoffmanni* and its subspecies see Table III, p. 219).

Specimens examined, 87.— **Costa Rica**, 9: Volcán de Irazú (alt. 6000–10,000 ft.), 9.

Colombia, 67.—*Western Andes* (3000–8000 ft.): Rio Lima, 11 (Am. Mus. 6, Br. Mus. 5); Rio Pescado, 2 (Am. Mus. and Br. Mus.); Rio Zapata, 2 (Am. Mus. and Br. Mus.); Las Pavos, 3 (Am. Mus. 2, and Br. Mus. 1); Castilla Mts., 2 (Am. Mus. and Br. Mus.); Las Tambas, 3 (Am. Mus. 2, and Br. Mus. 1); San Antonio, 9 (Am. Mus.); Cerro Munchique, 8 (Am. Mus.); Las Lomitas, 2 (Am. Mus.); Gallera, 2 (Am. Mus.); La Florida, 2 (Am. Mus.).— *Central Andes:* Miraflores (6200 ft.), 9 (Am. Mus.); La Sierra (6800 ft.), 7 (Am. Mus.); El Eden (8300 ft.), 5 (Am. Mus.).

Ecuador, 20.— Gualea, 5 (Am. Mus.); Zaruma, 4 (Am. Mus.); Palatanga, 4 (Br. Mus.); Chimbo, 2 (Br. Mus.); Baños, 2 (Br. Mus.); Aquabamba and Intac, 1 each (Br. Mus.); "Mt. Pichincha," 1, type of *Sciurus söderströmi* Stone (Mus. Phila. Acad. Sci.); Santa Rosa, 3, Loja, 2 (Am. Mus.).

Remarks.— Typical examples of *hoffmanni* present a wide range of individual variation in not only coloration and measurements but in cranial characters, especially in the form of the nasals, as shown by large series from each of a dozen or more different localities. The individual variation in coloration and size has already been sufficiently indicated.

The form of the nasals in most mammals is usually considered an important diagnostic feature, but the range of individual variation in most species of squirrels (and particularly in the *hoffmanni* group) is so great that the nasals afford no sure basis for the discrimination of local forms. In average specimens of *hoffmanni* the nasals are squarely truncate posteriorly and terminate practically on a line with the fronto-premaxillary sutures, but they often end a little in front of this line, and sometimes extend behind it. In other specimens they terminate far in front of it, with the posterior border slightly or deeply V-shaped, or even nearly square. In extreme cases the nasals terminate one fifth to one fourth of their length anterior to the fronto-premaxillary suture.

Formerly *hoffmanni*, as shown by the synonymy given above, was considered to be inseparable from *æstuans*, or merely a subspecies of it. While resembling *æstuans* in a general way in coloration, it is a much larger species, with a broader and relatively shorter tail, and is wholly separated from it geographically by the *griseogena* group.

The type locality of *Sciurus æstuans* var. *hoffmanni* was not definitely indicated in the original description, being given as "Costa Rica." Since two forms of the *hoffmanni* group occur in Costa Rica, *chiriquensis* of Bangs ranging from Chiriqui into the low coast districts of Costa Rica, it will be a convenience to restrict *hoffmanni* to the higher altitudes, or to the areas above 3000 feet, and to consider the type locality as San José, in the Volcán de Irazú district. This is warranted by the fact that Dr. Hoffmann, who collected the type, is known to have collected for a considerable period at San José during his explorations in Costa Rica.[1]

As thus restricted, specimens of *hoffmanni* from Costa Rica are indistinguishable from representatives of the *hoffmanni* group from the upper Rio Cauca valley, as recognized by Nelson (*l. c.*) in 1891 and by me (*l. c.*) in 1912. Specimens since received show that true *hoffmanni* ranges not only through the southern Western Andes of Colombia but also into the southern part of the Central Colombian Andes, and thence southward in the Andean region through central Ecuador to the northern border of Peru. Series of specimens from widely separated localities in this large area are practically indistinguishable, although it may be possible later to add slightly differentiated local forms to those here recognized, from points in the general area not represented by the material at present available.

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[1] Cabanis, Uebersicht der im Berliner Museum befindlichen Vögel von Costa Rica. Journ. für Orn., 1860, 1861, 1862, *passim*.

Subspecies *hoffmanni*, as at present known, presents an unusual case of discontinuous distribution among the smaller mammals, since it has thus far not been found in any part of northwestern Colombia. The mammal fauna of the Panama region is now fairly well known, and considerable collections of squirrels are available from the adjoining parts of Colombia and the coast of western Colombia, which regions, however, have not thus far furnished a single specimen related in any way to *hoffmanni*. Aside from several forms of *Microsciurus*, this non-*hoffmanni* region is occupied exclusively by the *Sciurus gerrardi* group of much larger and widely different squirrels; and from no point thus far have specimens of both the *gerrardi* and *hoffmanni* groups been received. In Colombia *hoffmanni* is absent from most of the western slope of the Western Andes, where it ranges from about 3000 to 8000 feet; but it has a closely related geographic representative in the low coast region of Ecuador, just as it has at low levels in Chiriqui and Costa Rica. The *hoffmanni* group ranges eastward from the Central Andes into the northern Eastern Andes to the Bogotá district, where it breaks up into several closely related local forms, some of which may be found later to merge into the *griseogena* group of the Sierra Merida and Codillera de la Silla of Venezuela; but such intergradation seems not as yet fully evident.

The wide hiatus in the present known range of the *hoffmanni* group at Panama and adjoining Colombian districts presents an interesting and difficult problem. Possibly its larger and probably aggressive neighbors of the *gerrardi* group have driven it out of their present range to the higher levels they do not affect. On the other hand it may more probably be due to long past geologic disturbances in the Isthmian area.

Mesosciurus richmondi (Nelson[1]), of northeastern Nicaragua and Honduras, is an outlying and the most northern member of the *Mesosciurus* group, allied to but quite distinct from *hoffmanni*, and separated from it by a considerable geographical area where neither species occurs, *hoffmanni* not extending, so far as known, north of Costa Rica.

Sciurus hoffmanni söderströmi Stone (*l. c.*) was based on a skin (without skull or measurements) from "Mt. Pichincha," collected by L. Söderström, and is thus described: "While a member of the *S. hoffmanni* group, this specimen is much more rusty-red, especially across the shoulders and on the fore legs, than any specimens I have seen from Costa Rica or any in a

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[1] *Sciurus richmondi* Nelson, Proc. Biol. Soc. Washington, XII, p. 146, June 3, 1898 (Escondido River, Nicaragua); Proc. Washington Acad. Sci., I, p. 100, May 9, 1899.—Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 660, Oct. 13, 1908 (Nicaragua).

Sciurus (*Guerlinguetus*) *richmondi* Allen, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 104, April 30, 1910 (Nicaragua).

considerable series with which Mr. Osgood has compared it in the Field Museum. In other respects it does not seem to differ." Through Dr. Stone's kindness I have been able to compare this specimen with others from near the type locality, and also with large series from both western Colombia and Costa Rica. It differs from all the others in being rather more heavily suffused with rufous than average specimens from elsewhere, but a number of others so closely approach it in this respect that it seems more likely to be merely an individual variant than the representative of a local form, in view of the known occurrence of typical *hoffmanni* at Gualea and other localities in the Ecuadorian Andes. In fact it does not differ more from one of the Gualea specimens than the four Gualea specimens do among themselves. Of 2 specimens from Loja, one is in the rufous phase and the other like Gualea specimens; and of 3 from Santa Rosa 1 is in the rufous phase and the others are like average specimens from the Ecuador Andes.

Microsciurus hoffmanni chiriquensis (*Bangs*).

Sciurus (*Guerlinguetus*) *æstuans chiriquensis* Bangs, Bull. Mus. Comp. Zoöl., XXXIX, No. 2, p. 22, April, 1902.—Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 66, Feb. 29, 1904 (referred to *hoffmanni*).

Type locality.— Divala, Chiriqui, Panama; altitude, near sea level.

Geographic distribution.— The low coast regions of Costa Rica and western Panama, south to Chiriqui and adjacent islands.

Description.— Similar to *hoffmanni* of the interior highlands of Costa Rica (Volcán de Irizú region), but slightly smaller, with harsher, shorter, and thinner pelage. There are no very appreciable color differences, except a general tendency to a more rufous tone of the upperparts and redder underparts.

The wide range of individual color variation in both forms is so extensive that specimens of the two forms from widely separated localities are often indistinguishable in coloration, although in general there is an appreciable average difference in coloration as well as in the character of the pelage. (For measurements see Table III, p. 219.)

Specimens examined, 90.—**Panama**, 80: Divala, Chiriqui, 14 (type and 13 topotypes, Mus. Comp. Zoöl.); Bouquete, Chiriqui, 19 (Am. Mus. 4, Br. Mus. 6, Mus. Comp. Zoöl. 9); Bogava, 12 (Br. Mus. 4, Mus. Comp. Zoöl. 8); Boqueron, 23 (Am. Mus.); Veragua, 2 (Br. Mus.); Tacoume, 1 (Br. Mus.); Cebaco Island, 5 (Br. Mus.); Sevilla and Insoleta Islands, each 1 (Br. Mus.); "Isthmus of Panama," 2 (Br. Mus.).

Costa Rica, 10: Boruca, 4; Rio Sicsicola, 2, Cuábre, 1, Tuis, 1, Pozo Azul, 1, Sta. Clara, 1 (all Am. Mus.).

Remarks.— As indicated above, *chiriquensis* may be regarded as a rather slightly differentiated form of *hoffmanni*, as the latter is here restricted, confined to the humid tropical lowlands of Costa Rica and Chiriqui, characterized mainly by thinner and more hispid pelage and the slightly more rufous tone of the coloration. The characters given by Bangs, based on Divala (Chiriqui) specimens, are the reverse of the acutal conditions, the words "more" and "less" in the expressions "more olivaceous" and "less brick-red" having been apparently accidentally transposed. The name, however, may be retained for the lowland form, in contradistinction from the form of the higher elevations of the interior, to which it seems convenient to restrict the name *hoffmanni*, so far as the Central American representative of the *hoffmanni* group are concerned.

Mesosciurus hoffmanni manavi (*Allen*).

Guerlinguetus hoffmanni manavi Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 589, Oct. 8, 1914.

Type locality.— Manavi, Rio de Oro, Ecuador.

Geographic distribution.— Coast region of western Ecuador.

Description.— "Similar to *G. hoffmanni* in size and general coloration, but with the proximal half or two thirds of the tail below nearly black, the hairs basally black narrowly ringed with fulvous giving a slightly grizzled effect, followed by a broad zone of black and a slight tipping of reddish orange; apical half or third of the tail below black slightly grizzled with fulvous or orange, the hairs broadly tipped with orange red; whole upper surface of the tail grizzled black and orange red, the surface color of the apical third almost wholly orange red.

"Total length (type), 410 mm.; head and body, 230; tail vertebræ, 180; hind foot (c. u. in dry skin), 52. Skull, total length, 52; zygomatic breadth, 31; interorbital breadth, 16; breadth of braincase, 24; length of nasals, 15; diastema, 13; maxillary toothrow, 8.8." — Allen, *l. c.*

Specimens examined, 12.— **Ecuador**: Manavi, 5; Esmeraldas, 3, Narinjo, 4 (Am. Mus.).

Remarks.— Differs from true *hoffmanni* of the elevated interior of Ecuador and the Western Andes in Colombia in the underparts being redder and the tail much blacker, especially on the under surface.

Mesosciurus hoffmanni quindianus (*Allen*).

Guerlinguetus hoffmanni quindianus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 587, Oct. 8, 1914.

Type locality.— Rio Frio, western slope of Central (or Quindio) Andes; altitude 3500 feet.

Geographic distribution.— Central Andes of Colombia, in the region of Salento and Laguneta, from about 3500 feet to about 10,000 feet.

Description.— "Upperparts with the mid-dorsal region black, extending (in different specimens) from the nape or shoulders to the base of the tail; rest of the upperparts finely grizzled yellowish and black varying (in different specimens) to ochraceous and black; outer surface of limbs and feet like the flanks; underparts ochraceous orange varying (in different specimens) to orange red; inside of limbs like the ventral surface; tail above black at the extreme base (for about 30 to 50 mm.), then orange (pale orange to orange red in different specimens) and tipped with black (usually for the terminal 40 to 50 mm.); under surface of tail grizzled fulvous and black, with black base and tip, and broadly edged with orange, the hairs individually black at base, then broadly banded with orange, followed by a broad band of black, and a very broad terminal band of orange; ears medium, clothed with very short hairs similar in color to the adjoining pelage.

"Total length (collector's measurements), 397 mm.; head and body, 215; tail vertebræ, 182; hind foot, 55. Six topotypes, total length, 400 (375–440); head and body, 221 (202–230, 1 at 242); tail vertebræ, 179 (146–198); hind foot, 56 (53–58). Eleven specimens from Salento (altitude 9000 feet), total length, 395 (390–418); head and body, 218 (205–226); tail vertebræ, 176 (162–203); hind foot, 56 (54–58).

"Skull (type), total length, 56; zygomatic breadth, 31.5; interorbital breadth, 16; breadth of braincase, 24; length of nasals, 16.4; maxillary toothrow, 8.6. Four topotypes, total length, 54.4 (53–55); zygomatic breadth, 31.3 (30–32); interorbital breadth, 16.1 (15.5–17); breadth of braincase, 23.4 (22.8–23.8); length of nasals 16 (15.5–16.5); maxillary toothrow, 8.2 (8–8.5). Salento and Laguneta skulls have practically the same measurements, the skulls from these four localities exceeding in size those of true *hoffmanni* from any of the numerous localities in Central and South America from which series of specimens have been received." — Allen. *l. c.*

Specimens examined, 15.— **Colombia**: Rio Frio, 6 (type and 5 topotypes); Salencio (Nóvita trail), 1; Salento, 2; Laguneta, 5; Passad e Torres, 1 (all Am. Mus.). [See Addenda, p. 308.]

Remarks.— The Laguneta series, from near Quindio Pass, is aberrant, approaching typical *hoffmanni*, the mid-dorsal region being only slightly darker than the flanks in two, while the other two agree with the type. Specimens from El Eden, on the eastern slope of the Central Andes, are indistinguishable from specimens of *hoffmanni* from Las Lomitas, San Antonio, and other points in the Western Andes, and also from those from Miraflores in the Central Andes. Specimens from near Bogotá (eastern slope of the Eastern Andes) are referable to *M. hoffmanni hyporrhodus* (Gray). They show, however, a tendency to a darkening of the mid-dorsal region, several specimens from Fusugasugá and Panamá being in this respect similar to typical examples of *quindianus.* Both forms agree in the deep orange red of the belly and the upper surface and edges of the tail. The relationships of these two forms, as regards coloration, may be expressed as follows: *quindianus* is normally a black-backed form, with occasional specimens in which the dorsal band is poorly developed; *hyporrhodus* is normally without a dark dorsal band, with occasional specimens in which it is more or less shown. It is pretty evident that both intergrade with *hoffmanni* to the southward in both the Eastern and Central Andes and probably in the Western Andes.

Mesosciurus hoffmanni hyporrhodus (*Gray*).

Sciurus hyporrhodus Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 419, Dec. 1867 (Santa Fé de Bogotá).

Type locality.— Santa Fé de Bogotá, Colombia. Type, No. 41.919, British Museum. Parzudaki.

Geographical distribution.— Bogotá district, Eastern Andes, Colombia.

Description.— Upperparts dull yellowish to reddish olive (in different specimens), the latter phase prevailing, the middle of the back sometimes a little darker than the sides; underparts orange yellow to deep orange red (in different specimens), the latter phase prevailing; tail at base, both above and below, like the back; middle two thirds of the tail heavily washed with orange rufous (varying in tone in different specimens), the hairs basally ringed with buffy yellow and black, the black greatly prevailing, with long orange yellow or orange red tips; under surface of tail more or less similar to the upper; tip of the tail with a broad subapical area of black, the extreme tip of the hairs some shade of orange; ears nearly concolor with the top of the head, with or without a conspicuous postauricular buffy patch of soft hairs; upper surface of the feet nearly like the sides, the hairs being minutely tipped with fulvous or rufous.

Total length (4 specimens, Fusugasugá), 393 (378–408); head and body, 220 (195–245); tail vertebræ, 194 (172–211); hind foot (c. u.) 59 (56–62).

Skull (4 specimens, same as above), total length, 52.9 (51.6–54.3); zygomatic breadth, 31.2 (31–32); interorbital breadth, 16.9 (16–18); breadth of braincase, 23.7 (23.3–25); length of nasals, 16.6 (15–18); diastema, 13.3 (13–14); maxillary toothrow, 8.8 (8.4–9). Three specimens from Panamá Largo (near Bogotá) give similar cranial and external measurements and agree in coloration with the Fusugasugá series.

Specimens examined, 23.— **Colombia**: Bogotá, 2, type and 1 specimen from Macanal, "near Bogotá" (Br. Mus.); Fusugasugá (alt. 6000 ft.), 7 (Am. Mus.); Panamá Largo, 3 (Am. Mus.); Monte Redundo, 1 (Am. Mus.); Quitame, 4 (Am. Mus.); Anolaima, 6 (Am. Mus.)[1]

Remarks.— *Mesosciurus hoffmanni hyporrhodus* is similar to typical *hoffmanni* in general coloration, but with a larger skull. The type has the axillæ marked with white (not mentioned in the description), as sometimes happens in true *hoffmanni.* My notes on the type state: "Less dark and more fulvous above than average *hoffmanni;* similar to deep rufous-bellied *hoffmanni* below, and tail similar to average *hoffmanni.*" Gray's description emphasizes "the softness and length of hair and hairy ears," but these are largely seasonal features.

The specimens of this form recorded above are all from localities near Bogotá, at altitudes of 6000 to 8000 feet. The Quitame specimens are winter (February) specimens, in very full coat, the pelage being thick and soft and the ears more hairy than in summer specimens, with the tufts of soft fulvous fur at the base of the ears well developed. These specimens indicate that Gray's type was a winter specimen.

Specimens of the *hoffmanni* group taken at different localities in the Colombian Andes show that the fluffy fulvous tufts at the posterior base of the ears are largely a seasonal feature, being conspicuously present in specimens taken in February, March and April, and practically absent or obsolete in August, September, October and November specimens. Similar tufts are well known to be a seasonal feature in many species of arboreal squirrels.

G. hoffmanni hyporrhodus is slightly larger than either true *hoffmanni* or *griseogena,* but it makes a distinct approach to the latter in coloration, especially through the increased amount of black at the tip of the tail, as compared with *hoffmanni.* Some of the specimens from the vicinity of Bogotá are, in fact, not easy to distinguish from *griseigena* without recourse to the labels. For the present, however, it seems better to recognize the two groups as specifically distinct.

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[1] Probably most, if not all, of the following 11 specimens from near Bogotá, formerly examined in the British Museum but not now available for reëxamination, are referable to *hyporrhodus:* Plains near Bogotá, 2; El Cofre, 2; La Palma, 2; Munzo Mines, 4; Quebrada de Murone, 1. All were collected by G. O. Childs, probably at or near his estate near Bogotá.

Table III.—Measurements of Species and Subspecies of Subgenus Mesosciurus.

Species, localities, and by whom collected and measured		External Measurements: Number of specimens	Total length	Head and body	Tail vertebræ	Hind foot	Cranial Measurements: Number of specimens	Total length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of nasals	Maxillary toothrow
hoffmanni	Aver.	6	391	208	199	54.5[c]	6	51.8	30.7	16.3	23.7	15.5	8.5
Volcan de Irazú, Costa Rica	Min.		375	202	167	52		50.3	29.8	15	23	14.2	8
M. A. Carriker, Jr.	Max.		420	217	215	55		53	32	17	24	16.2	9
chiriquensis	Aver.	6	409	216	193	54[c]	8	51.9	30.6	16.5	23.7	15.3	8.6
Various localities in Costa Rica	Min.		400	207	188	53		50.4	29.7	15.5	23	14	8.2
Carriker and Cherrie	Max.		420	222	200	55		53	31.7	17.5	24	16	9
chiriquensis	Aver.	18	424	236	184	54[c]	18	52.1	30.4	16.3	22.6	15.5	8.6
(Type and paratypes)	Min.		390	210	170	50		50	28	15	21.5	15	8
Divala, Chirique	Max.		440	255	220	56		54	32	17	24	17	9
W. W. Brown, Jr.													
chiriquensis	Aver.	10	382	208	172	51[s]	10	50.9	29.7	16	23.5	14.8	8.4
Boquete, Chirique	Min.		365	195	160	49		49.8	29	15	23	14	8
J. H. Batty	Max.		415	220	190	52		52	31	16.8	24	15.6	8.8
manavi	Aver.	3	392	224	173		5	50.9	30.7	17	24	15.2	8.5
Manavi, Ecuador	Min.		370	210	160			49.8	30	16	24	15	8
W. B. Richardson	Max.		410	230	180			52	31.2	18	24	15.5	9
quindianus	Aver.	6	400	221	179	56[c]	4	54.5	31.3	16.1	23.4	16	8.2
Rio Frio, Col.	Min.		375	202	146	58		53	30	15.5	22.8	15.5	8
L. E. Miller	Max.		440	230	198	58		55	32	17	23.8	16.5	8.5
quindianus	Aver.	11	395	218	176	56[c]	4	54	31.4	16	23.5	16.4	8.6
Salento, Col.	Min.		390	205	162	54		53	30	15	22	15.5	8.2
L. E. Miller	Max.		418	226	203	58		55.5	33	17	25	17	9
hyporrhodus	Aver.	6	393	220	191	57.6[c]	5	52.9	31.2	16.9	23.7	16.6	8.8
Fusugusagá, Col.	Min.		378	195	172	56		51.6	31	16	23.3	15	8.4
G. M. O'Connell	Max.		408	245	210	62		54.3	32	18	25	18	9

Mesosciurus griseogena griseogena (*Gray*).

Macroxus griseogena Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 429, Dec. 1867 (here a composite species).

S[ciurus] griseogena Thomas, Ann. and Mag. Nat. Hist. (7), VII, p. 193 (in text), Feb. 1901 (type locality fixed as "Venezuela").

Sciurus griseogena Robinson and Lyon, Proc. U. S. Nat. Mus., XXIV, No. 1246, pp. 144–146, Oct. 3, 1901 (San Julián, Venez.; description and notes on habits).— Osgood, Field Mus. Nat. Hist., Zoöl. Ser., X, No. 4, p. 26, Oct. 20, 1910 (mountains near Maracay, Aragua, Venezuela).— Allen, Bull. Amer. Mus. Nat. Hist., XXX, p. 255, Dec. 2, 1911 (Las Quiguas, San Esteban, Guarico, and Paramo de Rosas, northwestern Venezuela).

Sciurus griseogenys Alston, Proc. Zool. Soc. London, 1878, p. 667, part (the Venezuelan references only).

Sciurus æstuans var. *rufoniger* Allen, Mon. N. Amer. Rodentia, p. 757, 1877, part (the reference to the Venezuela record of Gray's *Macroxus griseogena* only. Not *S. rufoniger* of Pucheran 1845, nor of Gray 1842).

Sciurus hoffmanni Allen, Bull. U. S. Geol. Surv. (Hayden), IV, No. 4, p. 885, Dec. 11, 1878, part (the references to Gray's *Macroxus griseogena* only).

Sciurus æstuans var. *hoffmanni* Thomas, Proc. Zoöl. Soc. London, 1880, p. 401 (in text), part (*S. griseogenys*, = *Macroxus griseogena* Gray, considered to be "a very well marked variety" of *S. æstuans* but name *griseogenys* stated to be antedated by *hoffmanni* Peters).

Sciurus æstuans Alston, Biol. Cent.-Amer., Mammals, p. 132, June, 1880, part (the Venezuelan references only).

Sciurus griseogena klagesi Thomas, Ann. and Mag. Nat. Hist. (8), XIV, p. 240, Sept. 1914 (Galifaré, near Caracas, Venezuela).

Type locality.— "Venezuela," by designation of Thomas, 1901 (*l. c.*).

Geographic distribution.— Northwestern Venezuela.

Description.— Pelage short and close. Postauricular patches usually absent. General tone of upperparts yellowish olivaceous varying (in specimens from the same locality, sex, and season) to reddish olivaceous, the hairs plumbeous narrowly annulated at the tip with pale yellow and black varying (in different specimens) to ochraceous and black; flanks and outer surface of shoulders and fore limbs (especially the latter) brighter colored than back; ventral surface (in different specimens) pale orange yellow to deep reddish orange; chin, nose, and cheeks grayish buff; basal fourth to third of tail, both above and below, like the back; middle half of tail above (more or less in different specimens) deep red, varying from orange red to dark chestnut red, with little or no black visible; tip of tail deep black without red; median line of tail below grizzled rufous and black, the edges red; feet usually with a yellowish or ochraceous wash, due to the tipping of the hairs with these tints, but sometimes nearly plain dark olivaceous.

Total length (10 specimens, 6 males, 4 females, from San Julián, collected and measured by Captain Wirt Robinson, U. S. A.), 395.6 (383–412 mm.); head and body, 205 (195–216); tail vertebræ, 193.5 (182–199); hind foot (c. u.), 51.4 (50–53).

Skulls of the same specimens, total length, 50.4 (50–51.7); zygomatic breadth, 29 (28–30); interorbital breadth, 15.9 (15–16.2); breadth of braincase, 22.4 (22–23); length of nasals, 15.6 (15–16.5); diastema, 12.1 (12–12.5); maxillary toothrow, 8.5 (8.2–8.8).

Specimens examined, 39.— **Venezuela**: 1, type, by designation of Thomas, Dyson coll., without definite locality (Br. Mus.); San Julián, 1, San Esteban, 2 (Br. Mus.); San Julián, 20 (Robinson coll., Nat. Mus.); San Julián, 2 (Robinson coll., Mus. Comp. Zoöl.); without definite locality, 1 (Nat. Mus.); San Julián, 1, Macuto, 1, mountains near Maracay, 2 (Field Mus.); San Julián, 2, Guiguas, 3, and San Esteban, 3 (Am. Mus.).

Remarks.— As shown by the above-cited references, *Mesosciurus griseogena griseogena* has had a checkered nomenclatorial history. When first described by Gray it was assigned a range extending from Mexico through Central America to Venezuela and Bogotá, and was formerly considered referable by Allen, Alston, and Thomas (1877–1880) to *Guerlinguetus æstuans,* either as a synonym or as a variety, all the small tropical American squirrels, whether red-bellied or white-bellied, then being considered as merely forms of *æstuans.* In 1901 Thomas, when describing his *Sciurus griseogena meridensis,* designated "Venezuela" as the type locality, and indicated on the label one of Dyson's specimens as the type, Dyson's specimens (cited by Gray) best agreeing with Gray's description. The exact locality of Dyson's specimen has not, to my knowledge, been indicated, but some of the birds he collected in Venezuela have been recorded by Sclater[1] as having been collected at Coriana, near Cariaco, Cariaco, Galipan (altitude 8000 ft.), and Cumaná, and hence in the Cumaná Mountains, to the eastward of the Cordillera de la Silla.

In 1900 Captain (now Colonel) Wirt Robinson, U. S. A., collected 27 specimens of this squirrel at San Julián, on the northern coast of Venezuela, a few miles east of La Guaira, near sea level. All the specimens were taken between July 13 and August 10, and 17 of the 27 specimens have been examined by me in the present connection. In order authoritatively to determine the species a specimen was sent by Robinson and Lyon to Mr. Oldfield Thomas of the British Museum for comparison with Gray's type of his *Macroxus griseogena.* Thomas reported: "The squirrel is very typical of *S. griseogena* Gray, the specimen, No. 102721, being more exactly like the type than any others of the large numbers we have here" (Robinson and

[1] Proc. Zool. Soc. London, 1855, pp. 88, 237, 251, 259, and elsewhere.

Lyon, *l. c.*, p. 144). This specimen is still in the British Museum and was again compared by me with the type of *griseogena* and with other material from localities in northern Venezuela (8 specimens) and from the Merida district (12 specimens, including the type of *Sciurus griseogena meridensis* Thomas). My notes record that the coloration of the type of *griseogena* was found to be "exactly similar" to that of the specimens from San Esteban, La Guaira, and San Julián, with which it was compared.

Both *M. griseogena* and *M. g. meridensis* are subject to a wide range of individual variation in coloration, especially in the color of the ventral surface, which varies in specimens from the same locality from pale orange yellow to deep orange red. Also the intensity and amount of the fulvous suffusion of the upperparts varies widely, and is of course correlated with the color of the underparts.

The type of *Sciurus griseogena klagesi* Thomas was collected near where the large Robinson and Lyon series was taken.

In the light of present material the *griseogena* group proves to be not sharply distinguishable on the one hand from *chapmani*, nor on the other from some of the forms of the wide-ranging *hoffmanni* group. The difference in size between any of these closely related forms is very slight, while in coloration the chief difference is the greater extent of the black on the tip of the tail in the *griseogena* group as compared with *chapmani* and true *hoffmanni*. *M. h. hyporrhodus* of the Bogotá district is a large, intermediate, highly colored form, with nearly as much black at the tip of the tail as in *griseogena*, and leads into *M. h. quindianus*, which intergrades with true *hoffmanni* of western Colombia.

Robinson and Lyon's excellent description (*l. c.*) of *griseogena* was the first satisfactory account of the species, Gray's original description being very inadequate.

Guerlinguetus griseogena meridensis (*Thomas*).

Sciurus griseogena meridensis Thomas, Ann. and Mag. Nat. Hist. (7), VII, p. 192, Feb. 1901.— Allen, Bull. Amer. Mus. Nat. Hist., XXX, p. 225 (in text), Dec. 2, 1911 (Paramo de Rosas, alt. 10,800 feet).

Sciurus griseogena tamæ Osgood, Field Mus. Nat. Hist., Zoöl. Ser., X, No. 5, p. 48, Jan. 10, 1912 (Paramo de Tama, Colombia-Venezuela boundary, alt. 6000–7000 feet).

Type locality.— Escorial, Sierra de Merida, Venezuela; altitude 2500 m.

Geographic distribution.— Venezuelan Andes and their extensions northward.

Description.— Similar to *G. griseogena griseogena* in size and general coloration, but with the pelage much longer and softer; fluffy, fulvous, postauricular patches strongly developed; underparts deeper orange red, with a tendency to pure white axillar and inguinal patches, with sometimes a white median line; upper parts decidedly paler, the general tone an olivaceous gray, the annulations at the tips of the hairs clay color instead of yellow to ochraceous.

Total length (6 specimens, 3 males, 3 females, Sierra de Merida, topotypes, measured by the collector), 395 (380–410); head and body, 213 (190–220); tail vertebræ, 182 (170–190); hind foot (s. u.) 50.

Four specimens from Paramo de Tama (*S. g. tamæ* Osgood): "Total length, 396 (385–416); head and body, 216 (209–223); tail vertebræ, 180 (176–193); hind foot (c. u.) 54 (53–55)." — Osgood, *l. c.*

Skull (6 specimens, Sierra de Merida, same specimens as above), total length, 50.7 (48.5–52); zygomatic breadth, 29.4 (29–30); interorbital breadth, 15.9 (15–16.2); breadth of braincase, 23.3 (23–24); length of nasals, 16.2 (15.6–17); diastema, 12.4 (12–13); maxillary toothrow, 8.8 (8.3–9.2).

The *S. g. tamæ* series (3 skulls), total length, 52 (51–52.5); zygomatic breadth, 30.3 (30–30.5); interorbital breadth, 16 (15.8–16.2); breadth of braincase, 23.3 (23–24); diastema, 12.1 (11.5–13); maxillary toothrow, 8.3 (8–8.6).

Specimens examined, 57.— **Venezuela**: Escorial, Sierra de Merida, 4, type and 3 others (Br. Mus.); same locality, 10 (Nat. Mus.); same locality, 38 (Am. Mus.); Paramo de Rosas, near Guarico, 1 (Am. Mus.). **Colombia**: 4 (type and 3 topotypes of *S. g. tamæ*) Paramo de Tama, Colombia-Venezuela boundary (Field Mus.).

Remarks.— Guerlinguetus griseogena meridensis is the interior mountain form of *G. g. griseogena* of the northern coast mountains of Venezuela, from which it differs in the greater length and softness of the pelage, and the better development of the fluffy postauricular patches. The paler color of the upperparts and the deeper, redder tone of the ventral surface are additional features of differentiation, as are also the frequent development of patches of pure white on the ventral surface. These patches are very irregular as to size and shape; they are mainly inguinal and axillary in position, but appear also on the median line as small, more or less linear spots, which occasionally develop so as to form a continuous broad median line of white. In 33 specimens of typical *griseogena* only one is marked with white below, and this merely shows a tendency to whiteness at the axillæ. In a series of 12 well-made topotype skins of *meridensis*, from the Escorial de Merida, only 2 are prominently marked with white on the ventral surface. In a series of 26 flat skins (hunter's pelts) from Merida, bought by the American Museum of the Brinceñio brothers with other natural history material, 15 have more or less white on the ventral surface and 11 have none. Two of the three topotypes of *meridensis* in the British Museum also have small axillar and pectoral patches of pure white. In the topotype series of *S. g. tamæ* three of the four specimens have more or less white on the underparts, the amount and position of the white varying more or less with each. It is apparently an incipient tendency to white underparts, and occurs in many species of both American and Old World red-bellied squirrels, and in some species of South American *Oryzomys* and other Muridæ, and has little or no diagnostic importance, being evidently albinistic in character.

The *meridensis* form of *griseogena* seems to be restricted to the higher portions of the mountains, from the Cordillera de Merida northward, from probably about 3000 to 8000 feet. The *Sciurus griseogena tamæ* Osgood from the Paramo de Tama (6000–7000 ft.), does not seem separable from *meridensis* of Sierra de Merida. Other specimens have been examined from the intermediate Paramo de Rosas (from about altitude 7000 feet), near Guarico, and it probably occurs interruptedly at all altitudes above 3000 feet where conditions are favorable.

Mesosciurus chapmani (*Allen*).

Sciurus cestuans (err. typ.), Thomas, Journ. Trinidad Field Nat. Club, I, No. 7, p. 9, April, 1893. Trinidad.

Sciurus æstuans hoffmanni Allen and Chapman, Bull. Amer. Mus. Nat. Hist., V, pp. 209, 233, Sept. 21, 1893; *ibid.*, IX, p. 17, Feb. 26, 1897. Caparo, Trinidad. Not *hoffmanni* of Peters, 1864.

Sciurus chapmani Allen, Bull. Amer. Mus. Nat. Hist., XII, p. 16, March 4, 1899.

Sciurus (*Guerlinguetus*) *æstuans quebradensis* Allen, Bull. Amer. Mus. Nat. Hist., XII, p. 217, Dec. 20, 1899. Quebrada Secca, Venezuela.

Type locality.— Caparo, Trinidad.

Geographic distribution.— Island of Trinidad, Paria Peninsula, and the northern coast of eastern Venezuela, probably west to near Barcelona.

Description.— Pelage short and soft. Tail rather shorter than head and body. Upperparts nearly uniform dull yellowish olivaceous, the hairs plumbeous at base, annulated subapically with pale fulvous; hind limbs and feet like the dorsal surface; fore limbs a little more yellow than the flanks; a narrow yellowish eyering; postauricular patches apparently absent; ears concolor with the head; underparts orange, varying from pale orange to reddish orange, restricted in the females to the middle of the abdomen, the mammæ being surrounded by pale areas, more or less connected into pale lateral bands; chin and throat paler, the chin grayish buff, the throat brighter, passing into the bright orange-colored pectoral region; tail grizzled pale buffy gray and black, both above and below, the tips of the hairs reddish orange giving a strong superficial wash of red, including the tip.

Total length (6 adults from Trinidad, collector's measurements), 376 (367–390); head and body, 203 (197–208); tail vertebræ, 174 (162–192); hind foot (c. u.), 47 (45–48). A series of 9 skins from Cristobal Colon, Venezuela, collected and measured by Leo E. Miller: total length, 383 (360–405); head and body, 191 (173–200); tail vertebræ; 195 (180–215); hind foot (c. u.), 47.6. A series of 6 specimens (in Br. Mus.) from Ipuré, Cumaná, collected and measured by E. André: total length, 377 (371–381); head and body, 200 (192–206); tail vertebræ, 177 (173–180); hind foot (s. u.), 46 (44–48).

Skull (4 adults, Trinidad), total length, 49 (48–50); zygomatic breadth, 29 (28–30); interorbital breadth, 16 (15.5–16.5); breadth of braincase, 21.9 (21.5–22); length of nasals, 15 (14.5–15.5); diastema, 12 (12–12); maxillary toothrow, 8 (8–8). Seven adult skulls from Cristobal Colon, Venezuela, total length, 49.2 (48–51); zygomatic breadth, 29 (28–30); interorbital breadth, 16.3 (15.5–17.5); breadth of braincase, 22.3 (21.5–23); length of nasals, 14.6 (14–15); disatema 12 (11.7–12.5); maxillary toothrow, 8.2 (8–8.5).

Specimens examined, 35.— **Island of Trinidad**, 9: Princestown, 7; Caparo, 1 (type); Carenage, 1 (all Am. Mus.).—.**Venezuela**, 22: 1 (Br. Mus.); Cristobal Colon, 15 (Am. Mus.); Quebrada Secca, 3, type and topotypes of *Sciurus quebradensis* (Am. Mus.); Guanta, 1 (Nat. Mus.); Ipuré, Cumaná, 6 (Br. Mus.).

Remarks.— *Microsciurus chapmani* bears a general resemblance to *Guerlinguetus æstuans,* but is larger, with a relatively much shorter tail; upperparts yellowish olivaceous instead of reddish brown; ventral surface paler and chin buffy instead of grayish. It has no close resemblance to *M. griseogena,* its near neighbor in western Venezuela.

My *Sciurus quebradensis,* from the northern coast of Venezuela, does not, in the light of present material, seem to require nomenclatural recognition. The large series from the Paria Peninsula does not differ materially from Trinidad specimens, averaging perhaps slightly paler. The type and topotypes of *quebradensis,* from near Cumuná, are so nearly like the Paria Peninsula specimens as not to require separation. A single specimen from Guanta (No. 63213, Nat. Mus.), an immature female, is aberrant in the intense orange-rufous of the whole ventral surface and in the stronger suffusion of the fore limbs with rufous.

Mesosciurus chapmani tobagensis (*Osgood*).

Sciurus tobagensis Osgood, Field Mus. Nat. Hist., Zoöl., X, No. 4, p. 27, Oct. 20, 1910.

Type locality.— Island of Tobago, B. W. I.

Geographic distribution.— Island of Tobago, B. W. I.

Description.— Slightly smaller than *M. chapmani* but practically indistinguishable in color; there is a tendency to a little more black on the tip of the tail, but this proves an inconstant feature, 3 out of 9 Trinidad specimens having the tail tip as black as the Tobago specimens, while the majority of the Paria Peninsula specimens have the tail tip as black as any of the 5 specimens (type and topotypes) from Tobago; some have more black and others no distinct darkening of the tail tip.

"Total length, 330; head and body, 165; tail vertebræ, 165; hind foot (c. u.), 45"; measurements of the type, an immature female, as given by the author from the dry skin. Four topotypes are without flesh measurements. The hind foot (c. u.), in the skin of the type and 4 topotypes, measures 44 (42–45), or about 2 mm. less than in *chapmani*.

The total length of the skull cannot be given, the type and topotype skulls all lacking the occipital region. The available measurements of 4 adult skulls are as follows: zygomatic breadth (2 skulls only), 28 (27.5–28.5); interorbital breadth (4 skulls), 15.3 (15–15.5), breadth of braincase, 21.7 (21–22); length of nasals, 14.1 (14–14.3); diastema, 11.3 (11.2–11.5); maxillary toothrow (2 skulls), 8, 8.

Specimens examined, 7.—**Island of Tobago, B. W. I.:** 2, type and paratype (Field Mus.); 3, Nat. Mus.; 2, Br. Mus.

Remarks.— The original description states: "The heavy black tip of the tail is the principal character distinguishing this form [*tobagensis*] from *S. chapmani*" (Osgood, *l. c.*). The type is a young female in full, fresh pelage, and is rather more richly colored than any of the four topotypes in the National Museum, now before me, especially in respect to the ventral surface.

The main basis for the recognition of this form is its insular habitat and slightly smaller size as compared with the Trinidad and mainland representatives of the species, rather than the darkening of the tip of the tail, which is an inconstant character, especially prevalent in the Paria Peninsula series.

Mesosciurus nesæus (*G. M. Allen*).

Sciurus æstuans hoffmanni Robinson, Proc. U. S. Nat. Mus., XVIII, p. 651 (in text), Aug. 12, 1896. Margarita Island, Venezuela. Incidental reference.

Sciurus nesæus G. M. Allen, Proc. Biol. Soc. Washington, XV, p. 93, April 25, 1902.— Osgood, Field Mus. Nat. Hist., Zoöl., X, No. 4, p. 26, Oct. 20, 1910. Margarita Island.

Type locality.— El Valle, Margarita Island, Venezuela.

Geographic distribution.— Known only from Margarita Island, Venezuela.

Description.— Pelage long and soft. Upperparts light ochraceous, sparingly sprinkled with black; underparts bright orange-rufous; tail externally, both above and below, ochraceous, the hairs with a narrow median and a broad subapical annulation of black.

Total length (2 specimens, collector's measurements), ♂ 380, ♀ 405; head and body, 218, 217; tail vertebræ, 162, 188; hind foot, 45, 50; ear, 18, 18. Skull (same specimens), total length, ♂ 50, ♀ 51; zygomatic breadth, 28.3, 29; interorbital breadth, 17, 16.2; breadth of braincase, 22.5, 22; length of nasals, 15, 15; diastema, 12, 12; maxillary toothrow, 9, 8.8.

Specimens examined, 3.— **Venezuela**: Margarita Island, 3 (Field Mus., 2, Br. Mus., 1).

Remarks.— *Mesosciurus nesæus* is a surprisingly distinct form; in coloration it is unique among South American Sciuridæ, having no close resemblance to any of them. In size and proportions it is intermediate between its two mainland neighbors, *M. griseogena* and *M. chapmani*, and may have been derived from either, perhaps more probably from the former. It has evidently been long isolated from any mainland stock.

Mesosciurus griseimembra (*Allen*).

Guerlinguetus griseimembra Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 589, Oct. 8, 1914.

Type locality.— Buenavista, eastern slope of Eastern Andes, about 50 miles southeast of Bogotá, Colombia; altitude 4500 feet.

Geographic distribution.— Eastern slope of the Eastern Andes, from near Bogotá south to Andalucia.

Description.— "Upperparts finely grizzled ochraceous orange and black, not appreciably darker on the median dorsal area; underparts washed with pale ochraceous buff, strongest over the pectoral region, paler on the lower abdomen, lateral edges grayish, forming sometimes an ill-defined gray lateral line; chin and throat dull buffy gray; fore limbs entirely dark gray, the tips of the hairs lighter (whitish or buffy in different specimens); hind limbs externally like the body, internally gray like the fore limbs; ears colored like the adjoining surface, with a small patch of soft fulvous hairs at the posterior base; tail above washed with pale ochraceous, the general effect grizzled ochraceous and black, with a broad subterminal band of black, but base concolor with the back; under surface of the tail similar to the upper, broadly edged with ochraceous.

"Total length [type] (collector's measurements), 402; head and body, 219; tail vertebræ, 183; hind foot, 55. Type and 3 topotypes, total length, 394 (377–411); head and body, 213 (188–225); tail vertebræ, 181 (162–192); hind foot, 56 (55–58).

"Skull [type] total length, 51; zygomatic breadth, 31; interorbital breadth, 16; breadth of braincase, 22.7; length of nasals, 15.5; maxillary toothrow, 8. Four skulls (type and 3 topotypes, all adult), total length, 51.2 (50.3–53); zygomatic breadth, 30.6 (30–31); interorbital breadth, 16.1 (15–17); breadth of braincase, 22.7 (22–23.2); length of nasals, 15.5 (15–16); maxillary toothrow, 8.2 (8–8.6)." — Allen (l. c.).

Specimens examined, 5.— **Colombia**: Buenavista, 4; Andalusia, 1 (all Am. Mus.).

"The distinctive feature of *M. griseimembra* is the entirely gray fore limbs and the gray inner surface of the hind limbs, in which it differs strikingly from any of the forms of *M. hoffmanni*. In general coloration some specimens closely approach true *hoffmanni*, but the underparts average much paler, and the tail is paler and less heavily washed with ochraceous. It differs still more in coloration from *hyporrhodus*, specimens of which have been received from nearby localities in the Bogotá district to the northward; it is also smaller, the skull especially being smaller and more delicate. It is very much smaller than *quindianus* of the Central Andes (the skull 3 mm. shorter, and all other cranial measurements in proportion), and widely different in coloration.

Remarks. — "The four specimens of the type series vary considerably in the coloration of the underparts, ranging from a strong wash of ochraceous yellow (in one specimen) to a slighter wash of ochraceous buff. The single specimen from Andalucia is the palest of the five, and the gray of the limbs is the deepest and strongest, probably indicating that the extreme phase of the species may be looked for to the southward of the type locality." — Allen (*l. c.*).

Mesosciurus candalensis (*Allen*).

Guerlinguetus candalensis Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 590, Oct. 8, 1914.

Type locality.— La Candela, near San Agustin, Huila, Colombia; altitude 6500 feet.

Geographic distribution.— Southern part of the western slope of the Eastern Andes, Huila, Colombia, at altitudes of 4000 to 6500 feet.

Description.— "Upperparts (type) minutely punctated with pale orange yellow and dark brown, the hairs being blackish with minute yellow tips, the mid-dorsal region slightly darker than the flanks; underparts with the tips of the hairs white on the throat, pectoral region and middle of the lower abdomen, and pale ochraceous over the mid-abdominal region; lower border of the sides of the neck, outer surface of fore limbs, edge of thighs and outer surface of hind limbs washed with ochraceous; inner surface of fore limbs grayish white like the breast; inner surface of hind limbs with a broad central line of whitish bordered with a wash of ochraceous; tail above heavily washed with red or orange red, black for about 40 mm. at the tip; under surface of tail centrally grizzled with pale ochraceous and black, with a submarginal band of black, and a narrow edging of red, the tip of the tail black; ears colored like the surrounding surface, with barely an indication of a postauricular patch of soft fulvous hairs.

"Total length (type, collector's measurements), 380; head and body, 190; tail vertebræ, 190; hind foot, 53. Eight specimens (type and 7 topotypes), total length, 390 (380–420, only 1 above 400); head and body, 208 (190–230); tail vertebræ, 181 (160–200); hind foot (in dry skin), 52.8 (51–55).

"Skull (type), total length, 51.2; zygomatic breadth, 29; interorbital breadth, 16; breadth of braincase, 22.6; length of nasals, 15.5; maxillary toothrow, 8.5. Three adult skulls (type and 2 topotypes), total length, 51.3 (51–52.5); zygomatic breadth, 29.5 (29–30); interorbital breadth, 16 (16–16); breadth of braincase, 23 (22.6–23.3); length of nasals, 15.3 (15–15.5); maxillary toothrow, 8.4 (8.2–8.8)." — Allen, *l. c.*

Specimens examined, 11.— **Colombia**: La Candela, 8, type and 7 topotypes; La Palma, 3 (all Am. Mus.).

Remarks.— "The specimens referred to *G. candelensis* agree in the coloration of the upperparts and of the tail, but present a wide range of individual variation in the coloration of the underparts, which vary from nearly uniform clear grayish white to orange red over the whole abdominal area, with the upper chest and throat buff. In 3 of the specimens the underparts are almost wholly grayish white, with a tendency to a pale buffy wash over the middle of the belly; in 7 others the underparts are washed with pale orange yellow with the throat and chest mostly white; in one the whole undersurface is rich orange red. The specimen selected as type is of the medium phase of coloration. It may be added that the white on the underparts is plainly not albinistic, as in many normally red-bellied squirrels, the white being limited to the apical portion of the hairs, the basal portion being plumbeous.

"The nearest relative of *M. candelensis* is *M. griseimembra,* adjoining it to the northward in the Eastern Andes, which is similar in size and cranial characters, but radically different in coloration. In *candelensis* the legs and feet are not gray but like the adjoining parts of the body; the coloration of the upperparts is many shades darker, the yellow tips to the hairs being much shorter, and the tail is superficially dark red instead of pale ochraceous.

"It is interesting to note, in respect to its nearest geographical allies, that the range of *M. griseimembra* nearly joins it to the northeastward, while typical *hoffmanni* is abundant 50 miles to the westward at Almaguer and La Sierra, and also northward in the Western Andes, with which, however, *candelensis* has no near relationship." — Allen, *l. c.*

Subgenus **Histriosciurus** subgen. nov.[1]

Mesosciurus gerrardi gerrardi (*Gray*).

[Plate VIII, Figs. 4, 5; Plate XIII, Figs. 13, 14.

Sciurus gerrardi Gray, Proc. Zool. Soc. London, 1861, p. 92, pl. xvi ("New Grenada)."— Allen, Monogr. North Amer. Rodentia, 1877, p. 766; Bull. Amer. Mus. Nat. Hist., XXXI, p. 90, April 19, 1912 (Rio San Jorge, Colombia).

Macroxus gerrardii Gray, Ann. and Mag. Nat. Hist. (3), XX, 1867, p. 430. Same as *Sciurus gerrardi* Gray, 1861.

Sciurus variabilis Alston, Proc. Zool. Soc. London, 1878, p. 665, part, not of Is. Geoffroy.— Allen, Bull. U. S. Geol. and Geogr. Survey Terr. (Hayden), IV, No. 4, p. 884, Dec. 11, 1878, part, not of Is. Geoffroy.

Type locality.— "New Grenada"; exact locality not known, but doubtless Antioqua, Colombia (probably near Medellin). Type and topotype in British Museum. [See Addenda, p. 308.]

Geographic distribution.— Coast region of western Colombia.

Description.— Pelage short, coarse and stiff with very little underfur. Median upperparts, from top of head to base of tail (including its extreme

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[1] Type *Sciurus gerrardi* Gray.

Table IV.— Measurements of Species and Subspecies of Subgenus Mesosciurus.

		Number of specimens	Total length	Head and body	Tail vertebræ	Hind foot	Number of specimens	Total length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of nasals	Maxillary toothrow
griseimembra	Aver.	4	394	213	181	56.2[c]	4	51.2	30.6	16.5	22.7	15.5	8.2
Buenavista, Col.	Min.		377	188	162	55		50	30	15	22	15	8
G. M. O'Connell	Max.		411	225	192	58		53	31	17	23	16	8.6
candalensis	Aver.	11	393	209	182	52.8[c]	6	51.3	29.8	16	23.2	15.1	8.6
La Candela, Col.	Min.		380	190	160	50		50.5	29	15.5	23	15	8
L. E. Miller	Max.		420	230	200	55		52.5	30.8	16.3	23.6	15.5	9
griseigena	Aver.	10	396	205	193	51.4[c]	10	50.4	29	15.9	22.4	15.6	8.5
San Julien, Ven.	Min.		383	195	182	50		50	28	15	22	15	8.2
Wirt Robinson	Max.		412	216	199	53		51.7	30	16.2	23	16.5	8.8
meridensis	Aver.	6	395	213	182	50[s]	6	50.7	29.4	15.9	23.3	16.2	8.8
Merida, Ven.	Min.		380	190	170	—		48.5	29	15	23	15.6	8.3
G. Brinceño	Max.		410	220	190	—		52	30	16.2	24	17	9.2
chapmani	Aver.	6	376	203	174	47[c]	4	49	29	16	21.9	15	8
Trinidad	Min.		367	197	162	45		48	28	15.5	21.5	14.5	8
F. M. Chapman	Max.		390	208	192	48		50	30	16.5	22	15.5	8
chapmani	Aver.	9	383	191	195	47.6	7	49.2	29	16.3	22.3	14.6	8.2
Cristobal Colon, Ven.	Min.		360	173	180	—		48	28	15.5	21.5	14	8
L. E. Miller	Max.		405	200	215	—		51	30	17.5	23	15	8.4
tobagensis	Aver.	1	330	165	165	45[c]	4	—	28	15.3	21.7	14.1	8
Tobago Isl.	Min.							—	27.5	15	21	14	8
	Max.							—	28.5	15.5	22	14.3	8
nesæus	Aver.	2	392.5	217.5	175	47.5	2	50.5	28.7	16.6	22.3	15	8.9
Santa Margrita Isl., Ven.	Min.		380	218	162	45[c]		50	28.3	17	22.5	15	9
	Max.		405	217	188	50		51	29	16.2	22	15	8.8

basal portion) black, forming a broad median band, not sharply defined laterally from the sides of the body; sides of head, neck, shoulders, flanks, and thighs red, deepest on the shoulders and there often nearly meeting at the mid-dorsal line; underparts deep, dark red, varying in different specimens to deep orange, with or without (usually without) irregular small spots or streaks of clear white; outside and inside of limbs like the adjoining parts; tail above black at the base for the proximal two or three inches, the rest deep red, usually including the tip, but the terminal hairs are usually black basally, the black portion often visible through the surface wash of red, and sometimes the extreme tip is distinctly black; under surface of tail grizzled ochraceous and black for the basal two thirds, followed by a zone of black extending apically for two to three inches or more (in different specimens), or the median area may be almost wholly black as far as the apical third or fourth of the tail, the rest red; the hairs individually at the base are narrowly banded with ochraceous and black, giving a grizzled effect to the median area, followed by a broad zone of black, which is very broad proximally and narrows toward the tip of the tail, where the black is often wholly concealed by the long red tips of the hairs.

The above may be taken as a description of the average condition in typical *gerrardi*, but it is hard to find two specimens that wholly agree in coloration, even in a series from the same locality, while specimens from remote localities can be found that are so nearly alike as to be almost indistinguishable. The black of the median dorsal area is apt to be more or less finely punctated with red, and the thighs are usually paler than the shoulders, the hair tips being ochraceous or ochraceous red instead of deep red (or even brilliant red) as on the shoulders. The type of *gerrardi* is paler red, with the hair tips on the flanks, thighs, and sides of the lower back more ochraceous than is indicated in the above description, but, with the exception of the wholly white belly, the type is like many of the specimens I have examined from the coast region of western Colombia. Occasional specimens are more or less spotted with white on the ventral surface (never two in the same manner), and one (No. 32701, San Jorge) has the belly white washed lightly with red in places, where the tips of the hairs are red and the base white.

Total length, average 450 mm.; head and body, 225; tail vertebræ, 225; hind foot, 57.

Skull (No. 34130, Bagado), total length, 57; zygomatic breadth, 35; interorbital breadth, 18.5; breadth of braincase, 25; length of nasals, 19; maxillary toothrow, 9.6.

Unfortunately there is no series of specimens from the type region of *gerrardi* with trustworthy field measurements, nor is a series of measurable skulls available at this writing.

Specimens examined, 18.— **Colombia**: Medellin, 2 (Br. Mus. and Nat. Mus.); "New Granada," 2, type and paratype of *S. gerrardi* (Br. Mus.); Baudo, 2 (Am. Mus.); Bagado, 1 (Am. Mus.); Juntus de Tamaná, 1 (Am. Mus.); Sisto, 1 (Field Mus.); Rio Sipi, Chocó, 3 (Br. Mus.); "Valdivia, Lower Rio Cauca," 6 (Br. Mus.). [See Addenda, p. 308.]

Remarks.— *Sciurus gerrardi,* with its subspecies, has a range which extends along the Pacific coast from central Ecuador north to Panama, and east in the coast region of northern Colombia to Lake Maracaibo. It has become differentiated into a number of local forms, the extremes of which are very unlike, but which completely intergrade. One extreme is *S. gerrardi morulus* of Panama, with the upperparts grizzled ochraceous and black instead of red and black, and the black dorsal area obsolete or greatly reduced; the other is *S. gerrardi zuliæ* with the sides bright red and the dark dorsal area very broad and glossy black. Both intergrade with true *gerrardi* of the west coast region of Colombia.

The nomenclature of this group is much involved, several names having been more or less current for the typical form. The earliest name that has been applied to squirrels of the *gerrardi* group is *Sciurus variabilis* Geoffroy (Guérin's Mag. de Zool., X, 1832, Classe 1re, Mamm., pl. iv and text), which, based on three specimens from "Amérique," is not satisfactorily identifiable, and therefore not available. Most of the description applies very well to white-bellied specimens of typical *gerrardi* of the present paper, except that the tail is not "toujours beaucoup plus noire à la face postérieure qu' à l'antéreure," nor does the description agree with the colored plate. In the plate the lower back and rump are represented as red like the thighs and flanks, instead of being black as in the red and black forms of *gerrardi.* The species was based on specimens presented, with many others, by M. Plée, and presumed to have come from America, "car plusieurs de ces objects appartenaient à la Colombie, plusieurs aux Antilles et quelques-uns aux Etats-Unis." As indicative that the squirrels may have come from Colombia, the same collection contained a monkey which was described by Geoffroy in the same volume (*l. c.*, pl. vii and text) as *Stentor chrysurus* (= *Alouatta seniculus*), which he states is known to occur in Colombia, and to be common in the valley of the Rio Magdalena ("vallée de la Madeline"). Some years since I discussed at length (Bull. Amer. Mus. Nat. Hist., XII, 1899, p. 212, and *ibid.*, XX, 1904, pp. 434, 435) Geoffroy's *Sciurus variabilis* with reference to the large red-backed, white-bellied squirrel of the Santa Marta district, and reached the conclusion: "Indeed, it seems now safe to assume that the real type locality of *S. variabilis* is the Magdalena River of Colombia, at some point quite remote from the coast...."

On reëxamination of the subject, however, in the light of the present abundant squirrel material, I can find no form, nor even a single specimen, which agrees with the description and figure of *Sciurus variabilis.* The squirrels of this group from the Lake Maracaibo district (*Sciurus versicolor zuliæ* Osgood) have the basal fourth and the distal third of the tail deep black and the rest red (not the basal two thirds of the tail black and the rest red); the rump is black and not red; the belly is red, with sometimes irregular small spots of white, instead of the underparts wholly white, as only rarely and sporadically occurs in any of the *gerrardi* squirrels.

With a region of intergrades between the two forms, *zuliæ* passes into *Sciurus variabilis morulus* Bangs of the Rio Atrato and Panama regions, which has the black dorsal area much reduced, and the shoulders and entire sides of the body with the hair tips ochraceous and not red; only the extreme base of the tail black and the rest red; the belly red with small irregular spots of white in occasional specimens, not white. To the southward *morulus* passes into typical *gerrardi,* which has the mid-dorsal area black, the rest of the upperparts with the hair tips red, and red underparts; but with no red, in this nor in any other subspecies of the *gerrardi* group, on the lower back and rump, as represented in the figure of *S. variabilis.* These being the facts of the case it seems necessary to discard the name *Sciurus variabilis* as indeterminable.

The type of *Sciurus gerrardi* Gray, in the British Museum (No. 53. 12. 7. 2, ex coll. Verreaux), from "New Grenada," has been identified by Thomas (on label) as "closely agrees with the original figure of *variabilis* Geoff., and may be probably accepted as typical."[1] The lower back is not quite so black as in most specimens from western Colombia and the coast region of northern Ecuador, but (except for the white belly) it agrees quite as well with the average condition of a series of some 40 specimens from this general region as does the type of *versicolor,* and is quite as typical.

The type of *versicolor,* from Cachabi (or Cachavi), northern Ecuador (alt. 500 ft.), has a red belly, but the dark dorsal band so characteristic of this large series as a whole, is almost obsolete, and the tail is yellow (due apparently to bleaching) instead of deep red, and the tip of the tail has more black than most specimens of the series. Except for the yellow instead of deep red tail, the type is similar to numerous specimens from the Chocó region of Colombia.

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[1] The type locality is assumed by Thomas (verbally communicated to me) to be near the mouth of Rio Magdalena, which is unforested and not a squirrel country.

Mesosciurus gerrardi milleri (*Allen*).

Plate VIII, Figs. 9, 10; Plate XIII, Figs. 17, 18.

Sciurus milleri Allen, Bull. Amer. Mus. Nat. Hist., XXXI, p. 91, April 19, 1912.

Type locality.— Cocal, western slope of the Western Andes, Colombia; altitude 4000 feet.

Geographic distribution.— The known range extends from Cocal southwest along the western slope of the southern part of the Western Andes to Ricuarte (altitude 5000 feet).

Description.— Similar to *M. gerrardi gerrardi* in general coloration, but rather larger, with the base of the tail, both above and below, and the outer surface of the hind legs and feet black.

Typical *gerrardi* has the under surface of the base of the tail ochraceous or orange, the hind legs red like the sides of the body, and the upper surface of the hind feet with the hairs tipped with red. Typical *milleri* has the black of the lower back extending laterally over the thighs and outer surface of the hind legs; the upper surface of the hind feet is deep black, and the under surface of the proximal third of the tail is wholly black to the base.

Unfortunately the type of *milleri* [1] is not typical of the subspecies to which the name is applied, and might be referred to true *gerrardi* as an individual variant, were it not that all of the 8 specimens from Barbacoas and Ricaurte, about 100 miles southwest of Cocal have all the distinctive features of the type of *milleri* greatly intensified. If the type could be now chosen one of the Ricaurte specimens would be selected, in which the fore-limbs and sides of the body are redder, the base of the tail and the hind feet blacker.

Three adult males from Barbacoas, total length, 457 (450–470); head and body, 247 (240–250); tail vertebræ, 210 (200–230); hind foot, 59 (58–60). Adults from Ricuarte agree in measurements with the Barbacoas specimens.

Three adult male skulls (1 from Ricuarte, 2 from Barbacoas), all the adults that are available for measurement: Total length, 56.5 (56–57); zygomatic breadth, 33.6 (33–34); interorbital breadth, 18.5 (17.5–19.5); breadth of braincase, 25.3 (25–25.5); length of nasals, 18.6 (18.5–18.6); maxillary toothrow, 9.3 (9.2–9.5).

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[1] The collector's measurements of the type given in the original description should be corrected to read: Total length, 416; head and body, 223; tail vertebræ, 193, the collector, it has since been learned, having measured the tail to the tip of the hairs instead of to the end of the vertebræ.

Specimens examined, 14.— **Colombia**: Cocal, 2, type and topotype (Am. Mus.); Ricuarte, 4 (Am. Mus.); Barbacoas, 8 (Am. Mus.).

Remarks.— The occurrence of this strongly marked local form between the ranges of typical *gerrardi* and subspecies *versicolor* is quite unexpected. So far as now known, the range of subspecies *gerrardi* is the coast lowlands in the Chocó district, from Quibdo southward. [See Addenda, p. 308.] Barbacoas specimens are referable to *milleri,* which subspecies is otherwise known only from two localities on the western slope of the southern part of the Western Andes, Cali and Ricuarte, at altitudes of about 3000 to 5000 feet.

Mesosciurus gerrardi versicolor (*Thomas*).

Text Fig. 6 (p. 163).

Sciurus versicolor Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 385, Oct. 1900.

Type locality.— Cachabi (or Cachavi), Province of Esmeraldas, Ecuador; altitude 528 feet ("160 m.").

Geographic distribution.— Northwestern Ecuador, from sea level to about 3500 feet.

Description.— Similar in coloration to *M. gerrardi gerrardi,* but smaller. Some specimens are indistinguishable from true *gerrardi,* and it is difficult to give a distinctive diagnosis of either, owing to the wide range of individual variation, but the southern form (*versicolor*) appears to average much smaller than typical *gerrardi.*

Eight specimens from near the type locality (San Xavier, Pambilor, and Carondelet, altitude 60 to 160 feet), collected and measured by G. Fleming, give the following: Total length, 420 (404–444); head and body, 219 (200–237); tail vertebræ, 197 (190–216); hind foot (s. u.), 54 (53–56). Skulls of the same specimens, total length, 54.5 (53–56.3); zygomatic breadth, 32.8 (31–34); interorbital breadth, 18.3 (17–19); breadth of braincase, 24.7 (24–25.5); length of nasals, 16.6 (15–17.3).

Specimens examined, 16.— **Ecuador:** Cachavi, 2, type and paratype (Br. Mus.); Paramba, 2 (Br. Mus.); San Xavier, 5 (Br. Mus. 2, Nat. Mus. 3); Pambilor, 2 (Nat. Mus.); Carondelet, 3 (Nat. Mus.); Esmeraldas, 2 (Am. Mus.).

Remarks.— *M. gerrardi versicolor* is not easy to characterize so that it may be readily distinguished from frequent specimens of true *gerrardi,* owing to the wide range of individual variation common to both forms, through which specimens from northwestern Ecuador may be found which are practically indistinguishable from others from the Chocó of Colombia, yet there is a slight average difference in both color and size. Besides this their ranges are separated by that of the intervening form *milleri*, which in some respects is quite different from either *gerrardi* or *versicolor*. Thomas, in describing *versicolor*, took an Ecuador specimen for the type, but referred to this form nearly all of the Colombia specimens in the British Museum which I have referred above to *gerrardi*. On finding it necessary to take the name *gerrardi*, on the ground of its priority over *versicolor*, I at first presumed that *versicolor* would lapse into synonymy, but in working out the group it became evident that *versicolor* could be accepted for the most southern of the known forms of the *gerrardi* group. A specimen in the American Museum from Esmeraldas is almost an exact counterpart of the type of *versicolor*, while another specimen from the same locality is like average specimens from the Chocó of Colombia, except that it has a much larger area of black at the tip of the tail than is often met with in true *gerrardi*.

Mesosciurus gerrardi morulus (*Bangs*).

Text Fig. 14, showing mammæ (p. 165).

Sciurus variabilis morulus Bangs, Proc. New England Zoöl. Club, II, p. 43, Sept. 20, 1900.— Miller, Bull. 79, U. S. Nat. Mus., p. 338, 1912; Goldman, Smiths. Misc. Coll., LX, No. 22, pp. 4, 5 (in text), Feb. 28, 1913.

Type locality.— Loma del Leon, Panama.

Geographic distribution.— Humid tropical lowlands of central and western Panama.

Description.— Upperparts varying (in different specimens from the same locality) from light ochraceous buff to deep ochraceous buff or even ochraceous orange, finely lined with dusky, the hairs individually being black basally, ringed near the tip with ochraceous; median dorsal area slightly or not distinctly darker than the sides, but showing a tendency to a poorly defined dusky dorsal band; underparts ochraceous rufous, usually uniform but varied in some specimens with small spots of white in the axillæ, inguinal and pectoral regions, or along midline of belly; outside of fore limbs usually deeper ochraceous than the sides of the body or the thighs; inside of fore and hind limbs like the ventral surface; tail above at base nearly uniform with the middle of the back, or slightly darker in some specimens, the middle portion (about one half to two thirds of the total length) reddish ochraceous, with a long black tip, about equal in length to the dark basal portion but much blacker.

Total length (type), 450; head and body, 235; tail vertebræ, 215; hind foot, 56; ear, 24. Skull, total length, 55; zygomatic breadth, 33.6; interorbital breadth, 24; nasals, 18; maxillary toothrow, 9.5.

Total length (average of 20 specimens, collector's measurements), 448 (413–457); head and body, 232 (220–246); tail vertebræ, 220 (205–236); hind foot, 61 (59–64).

Skull (7 specimens), total length, 57 (55–59); zygomatic breadth, 33.6 (33–34.5); interorbital breadth, 18 (17–19); breadth of braincase, 24.4 (23–25); length of nasals, 17.6 (17–18.3); maxillary toothrow, 9.2 (9–9.6).

Specimens examined, 26.— **Panama**: Lion Hill, 3 topotypes (Mus. Comp. Zoöl.); Gatun, 14 (11 Nat. Mus., 3 Am. Mus.); Rio Indio, near Gatun, 6; Tabernilla, 2; Porto Bello, 1 (all in Nat. Mus.).

Remarks.— This is the extreme phase of the *gerrardi* group as regards coloration, the usual median black dorsal band being merely incipient or obsolete, and the coloration of the upper parts pale ochraceous, finely lined with black. It is also the most western, occupying the lowlands of the central and western parts of Panama. To the eastward in Panama it grades into *M. gerrardi choco* (Goldman). The limit of its range to the westward has not been determined, but it apparently does not reach Chiriqui, where it is replaced by *M. hoffmanni chiriquensis*.

Mesosciurus gerrardi choco (*Goldman*).

Sciurus variabilis choco Goldman, Smiths. Misc. Coll., LX, No. 22, p. 4, Feb. 28, 1913.

Type locality.— Cana (altitude 3500 feet), eastern Panama.

Geographic distribution.— Eastern Panama, "from sea level in the Tyra Valley to over 5000 feet altitude on the summits of the Pirri Range."— Goldman, *l. c.*

Description.— Similar in coloration to *Mesosciurus gerrardi morulus* but general coloration slightly more refescent, and with a well developed dorsal band of black, barely indicated in *morulus*. Also similar in size and cranial characters.

Total length (average of 10 specimens, collector's measurements), 446 (430–465); head and body, 235 (220–249); tail vertebræ, 212 (207–223); hind foot, 61.3 (58–62).

Seven skulls, total length, 56 (54.5–58); zygomatic breadth, 33.3 (32–35); interorbital breadth, 18.5 (17.5–20); breadth of braincase, 24.4 (23–25.6); length of nasals, 18 (17–19); maxillary toothrow, 9 (9–9).

Specimens examined, 28.— **Panama**: Cana, 5, type and 4 paratypes; Mt. Pirri, 6; Cerro Azul, 3; Marracante (sea level), 2; Boca de Cupe, 1 (all Nat. Mus.). **Colombia**: Chepigana, 4; El Real, 7 (Amer. Mus.).

Remarks.— As already noted, this subspecies intergrades to the westward with *morulus*. While the average difference is appreciable, the two forms are not strongly differentiated, some of the specimens being not readily separable except by the labels. The dorsal band in *choco* is usually strongly developed and in some specimens is clear glossy black. The base of the tail is also darker, both above and below, and the black tip of the tail is longer and more intensely black. It intergrades to the southward in the Atrato district of northwest Colombia with *M. gerrardi salaquensis*, in which the black dorsal band is broader, the shoulders, thighs, and sides redder, and the black tail tip absent.

Mesosciurus gerrardi salaquensis (*Allen*).

Sciurus gerrardi salaquensis Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 592, Oct. 8, 1914.

Type locality.— Rio Salaqui, northwestern Colombia.

Geographic distribution.— Known only from the drainage of the Rio Atrato.

Description.— "Similar to *S. gerrardi choco* in coloration and other external features, but tail without a black tip, and sides of body more ferruginous. Upperparts with a broad median black band extending from the shoulders posteriorly over the proximal third of the tail; sides ochraceous lined with black; outside of fore limbs orange red, inside like the ventral surface; thighs and outside of hind limbs paler than shoulders and fore limbs; underparts deep orange red, with irregular blotches and lines of white (in type a large pectoral area, axillæ, and a narrow median line white); tail above, proximal third black, rest bright red without black at the tip; under surface of tail for proximal third, and median area to end of vertebræ, grizzled ochraceous and black, distal two thirds and the tip broadly fringed with bright red. An adult female and a young female from the type locality are like the type."— Allen, *l. c.*

Total length (type, from skin), 470 mm.; head and body, 240; tail vertebræ, 230; hind foot, 60. Unfortunately the skull is badly broken, but apparently presents no tangible differences from the skulls of neighboring forms of the *gerrardi* group.

Specimens examined, 7.— **Colombia**: Rio Salaqui, 3 (type and 2 topotypes, Am. Mus.); Rio Atrato, 1, Nercua, 3 (Nat. Mus.). [See Addenda, p. 308.]

Remarks.— *Salaquensis* intergrades with subspecies *choco* of eastern Panama. To the southward along the coast it evidently intergrades with true *gerrardi*, as shown by specimens from Baudo and Bagado, through the great increase in intensity of the red on the flanks and limbs.

Mesosciurus gerrardi zuliæ (*Osgood*).

Sciurus versicolor zuliæ Osgood, Field Mus. Nat. Hist., Zoöl., X, No. 4, p. 26, Dec. 20, 1910; *ibid.*, X, No. 5, p. 47, Jan. 10, 1912.

Type locality.— Orope, Zulia, Venezuela. Type, No. 16584, ♂ ad., Field Mus. Nat. Hist.

Geographic distribution.— Known only from the lowlands of the lower Lake Maracaibo drainage, where it has been taken on both sides of the lake.

Description.— Median upperparts black — dull black on head and shoulders, deep black posteriorly; top and front of head and shoulders with the hairs minutely tipped with red, the amount of red variable in different specimens from nearly obsolete to a strong wash; lower edge of flanks deep red, varying from none (in the type) or a narrow lateral line to a broad band extending half way up the sides of the body and over the shoulders (rarely nearly meeting on the midline between the shoulders) and over the outer aspect of the thighs; underparts deep red (sometimes orange red), frequently with narrow streaks or small spots of white; outer and inner sides of limbs like the adjoining parts; upper surface of fore and hind feet red, varying in different specimens from light orange red to dark red; ears nearly naked, dark brown tinged (usually) with reddish; tail above with the proximal fourth black, in continuation of the black of the back; the apical third is wholly intense black, the intermediate portion red; under surface of tail black, only the middle portion broadly fringed with red.

Seven specimens (collector's measurements), from localities near the lower end of Lake Maracaibo: Total length, 434 (400–455); head and body, 226.5 (210–240); tail vertebræ, 210 (190–221); hind foot, 54.5 (50–57). Seven skulls (same specimens), total length, 56.3 (55–58); zygomatic breadth, 32.5 (31–35); interorbital breadth, 18 (17–19); breadth of braincase, 23.5 (23–24.5); length of nasals, 17.5 (16.5–19); maxillary toothrow, 9 (8.8–9.3).

Specimens examined, 8.— **Venezuela**: Orope, Depart. Zulia, 2 (type and paratype); Rio Aurare, 3; Encontrados, east of lower end of Lake Maracaibo), 2; Empalado Savannas (near the last-named locality), 1 (all Field Mus.).

Remarks.— The type is exceptional in almost altogether lacking red on the flanks and on the shoulders, where it is present in the paratype, but less pronounced than in most of the specimens from other localities. The four localities at which specimens were collected are all in the Maracaibo drainage, near the mouth of the lake.

Mesosciurus gerrardi cucutæ (*Allen*).

Sciurus variabilis Osgood (not of Thomas), Field Mus. Nat. Hist., Zoöl., X, No. 5, p. 47, Jan. 10, 1912.

Sciurus gerrardi cucutæ Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 592, Oct. 8, 1914.

Type locality.— El Guayabal, 10 miles north of San José de Cucuta, Colombia, near the Venezuelan boundary.

Geographic distribution.— Known only from the vicinity of San José de Cucuta, Colombia.

Description.— Similar to *M. gerrardi zuliæ* but much paler, the black of the upperparts duller and less glossy, the red of the underparts orange instead of orange red, the black on base of tail above and at tip more restricted and less intense.

"Type (collector's measurements), total length, 433 mm.; head and body, 215; tail vertebræ, 218; hind foot, 57. Skull, total length, 54; zygomatic breadth, 31.2; interorbital breadth, 17.4; breadth of braincase, 23.5; length of nasals, 16.5; maxillary toothrow, 9." — Allen, *l. c.*

Specimens examined, 5.— **Colombia**: El Guayabal, near San José de Cucuta, 5, type and 4 topotypes (Field Mus.).

Remarks.— "A single specimen from Rio San Jorge (alt. 1000 ft.), closely resembles *zuliæ* in general coloration, including the orange red feet so distinctive of *zuliæ, cucutæ* and true *gerrardi.* The proximal fourth of the upper surface of the tail is black, but the black at the tip of the tail is very restricted, consisting of only the terminal hairs. The bright red of the shoulders extends to the mid-dorsal line, as happens sometimes in both true *gerrardi* and *zuliæ.* It is probable that this specimen represents a geographical form occurring in northern and northwestern Colombia connecting *gerrardi* directly with *zuliæ.* Further material is necessary to determine the point, no other specimens from this large area being at present available." — Allen, *l. c.*

Mesosciurus saltuensis saltuensis (*Bangs*).

Sciurus variabilis saltuensis Bangs, Proc. Biol. Soc. Washington, XII, p. 185 Nov. 16, 1898.

Sciurus saltuensis Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 431, Nov. 28, 1904.

Type locality.— Pueblo Viejo, Santa Marta, Colombia; altitude 8000 feet.

Geographic distribution.— Sierra de Santa Marta, Colombia, at altitudes

Table V.— Measurements of Species and Subspecies of Subgenus Histriosciurus.

Species, localities, and by whom collected and measured		External measurements: Number of specimens	External: Total length	External: Head and body	External: Tail vertebræ	External: Hind foot	Cranial measurements: Number of specimens	Cranial: Total length	Cranial: Zygomatic breadth	Cranial: Interorbital breadth	Cranial: Breadth of braincase	Cranial: Length of nasals	Cranial: Maxillary toothrow
gerrardi		1	450	225	225	57[c]	1	57	35	18.5	25	19	9.6
milleri	Aver.	3	457	247	210	59[c]	3	56.5	33.6	18.5	25.3	18.6	9.3
Cocal, Col.	Min.		450	240	200	58		56	33	17.5	25	18.5	9.2
L. E. Miller	Max.		470	250	230	60		57	34	19.5	25.5	18.6	9.5
versicolor	Aver.	8	420	219	197	54[s]	8	54.5	32.8	18.3	24.7	16.6	9.1
Northwest Ecuador	Min.		404	200	190	53		53	31	17	24	15	9
G. Fleming	Max.		444	237	216	56		56.3	34	19	25.5	17.3	9.2
morulus	Aver.	20	448	232	220	61[c]	7	57	33.6	18	24.4	17.6	9.2
Western Panama	Min.		413	220	205	59		55	33	17	23	17	9
E. A. Goldman	Max.		457	246	236	64		59	34.5	19	25	18.3	9.6
choco	Aver.	10	446	235	210	61.3[c]	7	56	33.3	18.5	24.4	18	9
Eastern Panama	Min.		430	220	207	58		54.5	32	17.5	23	17	9
E. A. Goldman	Max.		465	249	223	62		58	35	20	25.6	19	9
salaquensis		Type	470	240	230	60[s]	0						
Rio Salaqui, Col.													
zuliæ	Aver.	7	434	226	210	54.5[c]	7	56.3	32.5	18	23.5	17.5	9
Northwest Venezuela	Min.		400	210	190	50		55	31	17	23	16.5	8.8
Osgood and Jewett	Max.		455	240	221	57		58	35	19	24.5	19	9.3
cuctæ		Type	433	215	218	57[c]	1	54	31.2	17.4	23.5	16.5	9
El Guayabal, Col.													
Osgood and Jewett													

of 5000 to 8000 feet. Rare at 8000 feet, and probably not ranging much above this altitude.

Description.— Similar to *M. saltuensis bondæ* (see below) but averaging much darker. Size and pattern of coloration exactly similar. Pelage thicker and softer, particularly on the ventral surface. (For measurements see Table V, p. 248.)

Specimens examined, 27.— **Colombia**: Pueblo Viejo, 2, type and paratype (Mus. Comp. Zoöl.); San Sebastian, 1, paratype (Mus. Comp. Zoöl.); El Libano (5500 ft.), 1 (Am. Mus.); Valparaiso (4500 ft.), 8 (Am. Mus.); Minca (2000 ft.), 8 (Am. Mus.); Cincinnati, 7 (Pittsburgh Mus.).

Remarks.— The Minca specimens are not typical; the locality is at the "lower border of the main mountain forests." Two series of specimens are labeled as having been collected at Minca, one of 8 specimens by M. A. Carriker, Jr., and one of 7 specimens by H. H. Smith. The Carriker specimens and one of the Smith specimens resemble typical *saltuensis* much more than they do *bondæ* of the more arid coast lowlands, but 6 of the Smith specimens are almost typical *bondæ*. Although all of both series are labeled Minca, probably they were really collected at different points varying considerably in elevation, Minca being "at the lower border of the main mountain forest, which here adjoins dry forest and open grass lands" (Smith).

Mesosciurus saltuensis bondæ (*Allen*).

Plate VIII, Figs. 7, 8; Plate XIII, Figs. 15, 16.

Sciurus variabilis Alston, Proc. Zool. Soc. London, 1878, p. 665, part, the Santa Marta, Colombia, specimens.

Sciurus variabilis variabilis Bangs (not of Geoffroy), Proc. Biol. Soc. Washington XII, pp. 183–185, Nov. 16, 1898; Proc. New England Zoöl. Club, I, p. 91, Feb. 23 1900 (Santa Marta region, Colombia, alt. 500–600 ft.). *Sciurus variabilis* I. Geoffroy, is here wrongly restricted to the "form of the coast of Colombia, in the Santa Marta District."

Sciurus saltuensis bondæ Allen, Bull. Amer. Mus. Nat. Hist., XII, pp. 213–217 Dec. 20, 1899; *ibid.*, XX, pp. 432–435, Nov. 28, 1904.

Type locality.— Bonda, altitude 200 feet, Santa Marta, Colombia.

Geographic distribution.— The arid coast region of the Santa Marta district of Colombia, north of the Sierra de Santa Marta, from sea level to about 2000 feet elevation.

Description.— Pelage long and soft. Two distinct seasonal pelages, differing in coloration.

General color of upperparts, in the full breeding pelage, including the outer surface of limbs and tail, deep red varying in different specimens from yellowish red to chestnut red; underparts, including inside of limbs, pure white; sides of head and throat fulvous; top of head with many of the hairs subapically annulated with black, giving a somewhat darker cast in contrast with the back; also hairs of lower back and basal part of tail annulated subapically with black; tail entirely deep red on both surfaces, the hairs usually red to the base, but sometimes broadly annulated near the base with black, the black subbasal zone gradually increasing in breadth on the apical third of the tail; the white on the inside of the limbs varies in extent, being sometimes nearly absent and sometimes extending to the ankles and wrists.

In the short new pelage the upperparts are usually yellowish red annulated with black, giving generally a more or less olivaceous effect, the fore limbs, the inner edge of the thighs and a narrow lateral line clear yellowish red. The young in first pelage are usually like the adults in the short new coat.

Measurements of 13 males and 16 females (collected and measured by members of the H. H. Smith Santa Marta expedition), all from Bonda: Total length, *males*, 472 (439–520) mm., *females*, 477 (448–500); head and body, *males*, 472, *females*, 477; tail vertebræ, *males*, 227 (205–255), *females*, 223 (215–250). Measurements of 10 specimens (males and females, collected and measured by W. W. Brown, Jr., for the Bangs Brothers,[1] at Santa Marta, 7 miles from Bonda): Total length, 476 (460–500); head and body, 237 (230–350); tail vertebræ, 240 (225–250); hind foot, c. u., 56.1 (53–60).

Ten adult skulls (all but two with the teeth considerably worn) from Bonda give the following: Occipitonasal length, 56.3 (55–58); zygomatic breadth, 31.5 (31–32); interorbital breadth, 18.5 (18–19); breadth of braincase, 23.5 (22.5–24.5); length of nasals, 18 (17.5–19); diastema, 13.6 (13–14); maxillary toothrow, 9.3 (9–9.7).

The Bonda specimens show not only a wide range of individual variation in color, but also a large amount of seasonal variation in the length of the pelage as well as in its coloration. In the perfectly developed breeding pelage a broad mantle of long red hair covers the shoulders and extends along the flanks, which is absent in the early stages of the shorter, yellower and more annulated coat of the succeeding pelage. This is demonstrated by specimens in molt, in which both pelages are shown. The long red hair of the upperparts probably comes in gradually and not by a second full molt.

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[1] *Cf.* O. Bangs, Proc. Biol. Soc. Washington, XII, p. 186, Nov. 16, 1898. These are the first 10 specimens of Bangs's table of measurements.

It may be noted that while the total length in the Smith specimens is practically the same as in the Brown specimens, the ratio of the length of the tail vertebræ to the total length is about 2.5% less in the former than in the latter, due undoubtedly to different methods of taking the length of the tail.

A single specimen (♀ ad.) from Don Diego, at mouth of Don Diego River (sea level), is melanistic. The upperparts are very dark, the hairs being merely slightly tipped with ochraceous, black prevailing on the median area; the usual white area below is bordered with a narrow line of black, which also outlines the white on the inside of the limbs, and the throat is black. The tail is of the normal deep red, but elsewhere red has been largely replaced with black.

Specimens examined, 60.— **Colombia**: Bonda, 46[1] (36, Am. Mus., 10, Nat. Mus.); Minca, 4 (Am. Mus.); "South America," 1 (Nat. Mus.); Minca, 8 (Pittsburgh Mus.); Don Diego, 1, melanistic (Am. Mus.).

Remarks.— Mr. Bangs's application of the name *Sciurus variabilis* Geoffroy to the Santa Marta squirrel proves to have been wholly unjustifiable.[2] To no large Colombian squirrel is it hardly less applicable than to this species. The type in all probability came from somewhere in northwestern Colombia but as yet no specimens are known to which the description and figure are applicable. The probability is that the name was based on some at present unknown phase of the *Sciurus gerrardi* group, carelessly and improperly described and very erroneously figured, and until some form more closely agreeing with the alleged characters has been discovered than is now known it seems best to treat Geoffroy's name as indeterminable, for reasons already fully given in the present paper (*antea*, pp. 239, 240). The name has been applied by authors to all of the large South American squirrels with red backs and white bellies, from northern Colombia and Panama to Peru and Brazil.

Mesosciurus saltuensis magdalenæ (*Allen*).

Sciurus saltuensis magdalenæ Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 593, Oct. 8, 1914.

Type locality.— Banco, Rio Magdalena, a few miles above mouth of Rio Cesar, Colombia; altitude 50–100 feet.

Geographic distribution.— Known only from the type locality.

Description.— "Pelage short, coarse and rigid, almost without underfur. Upperparts uniform deep red except front and sides of head, which are orange yellow; underparts and proximal portion of inside of limbs pure white; chin orange yellow, passing into orange red on the throat, sharply contrasting with the white of the lower throat and chest; tail wholly intense

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[1] The Bonda specimens, originally 60 in number, were all collected by the H. H. Smith Expedition, but some have since been sent to other Museums, including 10 to the U. S. National Museum.

[2] *Cf.* Allen, Bull. Amer. Mus. Nat. Hist., XII, p. 216; *ibid.*, XX, p. 434, and *antea*, p. 239.

dark red from base to tip, both above and below; upper arms and thighs deep red like the upperparts; fore and hind feet orange red.

"In a second specimen (topotype) the red of the flanks and limbs is still darker, the hairs of the back subapically narrowly ringed with black, thus distinctly darkening the median dorsal area, which is extended over the proximal third of the tail.

"Total length (type), 434 mm.; head and body, 245; tail vertebræ, 189; hind foot, 56; topotype (♂ ad.), 422, 238, 184, 60. The skull has been temporarily mislaid; measurements of it may be given later." — Allen, *l. c.*

Specimens examined, 2.— **Colombia**: Banco, Rio Magdalena, near mouth of Rio Cesar, 2, type and topotype (Am. Mus.).

Remarks.— Similar in pattern of coloration to *M. saltuensis bondæ*, but the pelage is coarse and hispid instead of long and soft, and the red is much darker and more vivid. The type locality is at the mouth of the Rio Cesar, which has its source in the Sierra de Santa Marta. Doubtless squirrels of the *saltuensis* group will be found at favorable localities throughout the course of the Rio Cesar, the mouth of which is in the humid tropical, while the region about Bonda is arid, the change in the character of the pelage and the intensification of the color in *magdalenæ* being doubtless due to its more humid environment.

Mesosciurus pyrrhinus (*Thomas*).

Sciurus variabilis Tschudi (not of Geoffroy), Fauna Peruana, I, Therologie, pp. 155, 160, pl. x.— Allen, Mon. N. Amer. Rodentia, 1877, p. 768, part, only the reference to Tschudi.— Thomas, Proc. Zool. Soc. London, 1893, p. 337 (Chanchamayo, Peru).

Sciurus pyrrhinus Thomas, Ann. and Mag. Nat. Hist. (7), II, p. 265, Sept. 1898.

Type locality.— Garita del Sol, Vitoc, Peru.

Geographic distribution.— Eastern slope of the Andes in central Peru, latitude 9° to 12° south (Tschudi), from the lower edge of the cedar region to the upper forest region, about 2000–5000 feet (Tschudi).

Description.— Similar in size, cranial and external features to *Mesosciurus saltuensis bondæ*, but much darker red above, and either white or red or patchy red and white below.

Pelage long, thick and soft. Superficially dark red above from nose to end of tail, the hairs annulated narrowly on apical half with red and black, giving a grizzled red-black general effect; basal half of tail with more black than the apical half; underparts bright red with small irregular patches of white on throat, axillæ, lower breast and inguinal region; tail below annulated with three bands of black and two of rufous, the outer one wider and broadly fringed with red.

Table VI.— Measurements of Species and Subspecies of Subgenus Histriosciurus.

Species, localities, and by whom collected and measured		External measurements					Cranial Measurements							
		Number of specimens	Total length	Head and body	Tail vertebræ	Hind foot	Number of specimens	Total length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of nasals	Diastema	Maxillary toothrow
saltuensis	Aver.	10	476	237	240	56.1[c]	10	54.4	30.5	18	23.8	17.1		
Sierra de Santa Marta, Colombia	Min.		460	230	225	53		53.5	30	17.5	23	16		
W. W. Brown, Jr.	Max.		500	250	250	60		56	31	19	24.5	18		
bondæ	Aver.	29	471	244	227	—	10	56.3	31.5	18.5	23.5	18	13.6	9.3
Bonda, Sta. Marta, Colombia	Min.		439	234	205	—		55	31	18	22.5	17.5	13	9
H. H. Smith	Max.		520	270	250	—		58	32	19	24.5	19	14	9.7
magdalenæ	Aver.	2	428	235	187	58[c]								
Rio Cesar, Col.	Min.		422	238	184	56								
G. M. O'Connell	Max.		434	242	189	58								
pyrrhinus	Type		448	240	208	59	type	52	33.5	18	—	16.5	15.2	9.6

In 9 specimens examined, all from central Peru, the ventral surface is wholly red in 1, wholly white in 4, and red patched with white in 4 others.

"Head and body, 240 mm.; tail, 208; hind foot (wet), 59; ear (wet), 21.

"Skull: greatest length, 52; basilar length, 46; greatest breadth, 33.5; nasals, 16.5 × 8.4; interorbital breadth, 18; intertemporal breadth, 19; diastema, 15.2; palate length from hensilon, 26.7; length of upper tooth-series, 9.6." — Thomas, *l. c.*

Specimens examined, 9.— **Peru**: Chanchamayo, 7, including type (Br. Mus.); Chanchamayo, 2 (Field Mus.).

Remarks.— *Mesosciurus pyrrhinus* presents a remarkable similarity to *M. saltuensis bondæ*, considering the remoteness of their ranges, which are separated by more than 2000 miles. In size, cranial characters, pelage, pattern of coloration, and in color, they are so similar that were their ranges contiguous there would be no reasonable ground for not considering their relationship as merely subspecific. In the *saltuensis* group the ventral surface is white, in *pyrrhinus* it may be either white or red, or a patchy mixture of both, and there is a stronger mixture of black in the basal third or half of the tail.

This species was described and figured (both the red-bellied and white-bellied phases) by Tschudi (*l. c.*), under the untenable name *Sciurus variabilis*, who states that it is abundant in the forest of the eastern slope of the Andes between latitudes 9° to 12° south.

Genus **Guerlinguetus** *Gray.*

Text Figs. 8, 15 (pp. 163, 165); Plate IX, Figs. 4–6; Plate XIII, Figs. 19–24.

Guerlinguetus Gray, London Med. Repos., XV, p. 304, April, 1821 (genus).— Nelson, Proc. Washington Acad. Sci., I, pp. 30, 98, pl. i, fig. 7, May 9, 1899, part (subgenus).— Miller, Bull. 79, U. S. Nat. Mus., p. 334, part (subgenus).

Macroxus F. Cuvier, Dents de Mamm., pp. 161, 162, 255, pl. lvi, 1823.— Lesson, Gray, Trouessart, and others, in part. Type, by designation of Thomas, 1897, *Sciurus æstuans* Linné.

Type (by tautonymy), *le guerlinguet* Buffon = *Myoxus geurlingugus* Shaw = *Sciurus guerlinguetus* Gray = *Sciurus æstuans* Linné.

Size small; mammæ, 8; tail long, about 50% of total length.

Premolars, $\frac{1}{1}$. Skull long and narrow; dorsal outline less convex than in *Leptosciurus, Notosciurus*, and in most forms of *Mesosciurus;* malar narrow, slightly expanded vertically on the upper border, which is depressed behind the malar process; m^1 and m^2 of the usual sciurid type (nearly as in typical *Sciurus*), with the cusps on the outer border well developed, as are also the intervening cusplets, differing thus strongly from those of *Leptosciurus*, presenting four distinct crenulations on the outer border; p^4 and m^3 have the crown cup-shaped, the crenulations on the outer border obsolete.

Geographic distribution.— The lower drainage areas of the Amazon and Orinoco rivers, the northern coast region of Brazil, and the forested parts of the Brazilian Highlands south to Paraná and São Paulo. (See Map, p. 301.)

Remarks.— *Guerlinguetus* is most nearly related to *Mesosciurus*, from which it is readily distinguishable by the possession of 8 mammæ instead of 6, and by the much longer and narrower tail. In the general form of the skull and in the character of the dentition there is no very marked difference. The nasals, however, are shorter, their length being about 82% of the interorbital breadth instead of from 94% or more as in *Mesosciurus;* the skull is also narrower in comparison with the length, but the difference, while fairly constant, is too slight to be very impressive when reduced to percentage.

Guerlinguetus, as here restricted, comprises *G. æstuans* and *G. alphonsei* with their respective subspecies, which constitute the typical section of the genus. *G. ingrami* is aberrant, but is better referred here than to any of the other groups here recognized as generic. It differs from the typical forms in being distinctly larger, in the coarser, longer pelage, and somewhat in style of coloration. The skull is much narrower in proportion to the length, and the teeth differ markedly in respect to the shape and the character of the crown surface of m^3, which has a high anterior conical cusp. (*Cf.* Plate XIII, Figs. 23, 24.) *G. ingrami* differs also in the physical character of its habitat, its distribution comprising the mountainous parts of southeastern Brazil, in contrast with the excessively humid tropical forests of the Amazon and Orinoco. *G. ingrami* could well be separated from the *æstuans-alphonsei* group as a separate subgenus of *Guerlinguetus,* on the basis of the above-stated differences.

Species and Subspecies of Guerlinguetus, with type localities and statement of number of specimens examined.

Guerlinguetus æstuans æstuans (Linné). Guiana. Specimens examined, 17.

Guerlinguetus æstuans gilvigularis (Wagner). Borba, Brazil. Specimens examined, 18.

Guerlinguetus æstuans macconnelli (Thomas). Near base of Mount Roraima, British Guiana. Specimens examined, 1, the type.

Guerlinguetus æstuans quelchii (Thomas). Kanucha Mountains, British Guiana. Specimens examined, 5.

Guerlinguetus æstuans venustus subsp. nov. Southern base of Mount Duida, Venezuela. Specimens examined, 1.

Guerlinguetus alphonsei alphonsei (Thomas). San Lourenço, near Pernambuco, Brazil. Specimens examined, 11.

Guerlinguetus alphonsei paraensis (Goeldi). Para, Brazil. Specimens examined, 23.

Guerlinguetus ingrami (Thomas). Tunnel, southern Minas Geraes, Brazil. Specimens examined, 50.

Key to the Species and Subspecies of Guerlinguetus.

Size smaller; pelage short and thin.
- Tail washed with rufous.
  - Upperparts grizzled ochraceous rufous and black; below rufous or orange rufous .... *æstuans* (p. 256)
    - Similar to *æstuans* but smaller and paler .... *gilvigularis* (p. 257)
    - Similar to *gilvigularis* but paler .... *quelchii* (p. 259)
  - Upperparts more olivaceous, underparts orange buff .. *macconnelli* (p. 259)
- Tail washed with white.
  - Upperparts olivaceous gray; below buff, whitish laterally . *alphonsei* (p. 261)
  - Upperparts more ochraceous .... *paraensis* (p. 261)

Size larger; pelage long and full.
- Tail washed with pale fulvous .... *ingrami* (p. 262)

Guerlinguetus æstuans æstuans (*Linné*).

Plate IX, Figs. 4–6; Plate XIII, Figs. 19, 20.

Sciurus æstuans Linné, Syst. Nat., ed. 12, I, 1766, p. 88 (Surinam).— Desmarest, Nouv. Dict. d'Hist. Nat., nouv. éd., X, 1817, p. 109 (= *Le grand Guerlinguet*, Buffon, Hist. Nat., Suppl., VII, 1789, p. 262, pl. lxv).— Alston, Proc. Zool. Soc. London, 1878, p. 668, part.— Thomas, Ann. and Mag. Nat. Hist. (8), VI, p. 185, Aug. 1910 (Supinam River, Demerara).

Sciurus æstuans var. *æstuans* Allen, Mon. N. Amer. Rodentia, p. 756, Aug. 1877, part; Bull. U. S. Geol. Surv. Terr. (Hayden), IV, No. 4, p. 885, Dec. 11, 1878, part.

Sciurus æstuans var. *guianensis* Peters, Monatsb. K. P. Akad. Wissen. Berlin, 1863 (1864), p. 655 (British Guiana).

Macroxus æstuans Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 432, Dec. 1867, part.

Myoxus guerlingugus Shaw, Gen. Zool., II, pt. 1, 1801, p. 171, pl. clvi, 1801 (= *le grand Guerlinguet* of Buffon).

Type locality.— Surinam.

Geographic distribution.— The Guianas.

Description.— Pelage short, soft. Tail vertebræ equal to or slightly longer than head and body. Postauricular patches buffy yellow, restricted to a small area close to the posterior base of the ear; usually inconspicuous and sometimes absent. Upperparts grizzled ochraceous rufous and black, the hairs black coarsely annulated near the tip with ochraceous rufous; a narrow yellow eye-ring; chin, throat, and inside of fore limbs grayish brown with a buffy wash; chest and abdomen orange or orange rufous; tail above black washed with orange, the hairs basally grizzled dull yellowish and black, subapically broadly banded with black and tipped with orange; tail not tipped with black; under surface of tail grizzled orange and black; feet dusky grayish brown minutely punctated with fulvous or rufous.

Total length, 365 mm.; head and body, 180; tail vertebræ, 185; hind foot (s. u.), 44, c. u., 47. Skull, total length, 45; zygomatic breadth, 27; interorbital breadth, 16; breadth of braincase, 21; length of nasals, 12; diastema, 11; maxillary toothrow, 7. (Measurements of an old female from Bonasica, Essequibo River, British Guiana. For additional measurements see Table VII, p. 264).

Specimens examined, 17.— **British Guiana**: Surinam River, 8; Bartica Grove, 3 (all Br. Mus., coll. F. V. McConnell); Kaieteur Falls, 1 (Am. Mus.); Potaro Landing, 2 (Am. Mus., 1; Brit. Mus. 1); Potaro Highlands, 1 (Br. Mus.). **French Guiana**: Ipousin, Approague River, 1 (Br. Mus.).

Remarks.— *Sciurus æstuans* was the first South American squirrel recognized in systematic zoölogy, it having been technically named by Linné in 1766. His description was very brief and quite insufficient for satisfactory identification. The habitat of the species was given as "Surinam"; and by common consent the name has come to be assigned to one of the small squirrels of the Guianas. The name as employed for nearly a century was a 'blanket name' for practically all of the small squirrels of tropical America. The group has since been separated into numerous species and subspecies, some of them widely different from *æstuans* as now restricted.

Typical *æstuans* is poorly represented in the museums of this country; the present description is based on the series in the British Museum, but only one of them has measurements taken before skinning.

There is, as usual, a considerable range of individual variation in coloration and size, but the above description is believed to represent the average conditions.

Guerlinguetus æstuans gilvigularis (*Wagner*).

Plate IX, Fig. 8; Plate XIII, Figs. 21, 22.

Sciurus gilvigularis Wagner, Arch. f. Naturg., 1842, ii, p. 43; *ibid.*, 1845, i, p. 148; Abhandl. math-phys. Cl. Akad. München, V, 1850, p. 283.

Sciurus gilviventris Pelzeln (ex Natterer), Verhandl. z.-b. Gesell. Wien, XXXIII, Beiheft, 1883, p. 59 (Borba, Brazil).

Sciurus æstuans gilvigularis Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 340, Oct. 8, 1904 (Suapuré, La Union, and El Llagual, Venezuela); *ibid.*, XXVIII, p. 146, May 27, 1910 (Rio Mocho, Venezuela).

Sciurus (*Guerlinguetus*) *æstuans gilvigularis* Allen, Bull. Amer. Mus. Nat. Hist., XXX, p. 255, Dec. 2, 1911 (Rio Mocho).

Sciurus æstuans gilvigularis Thomas, Ann. and Mag. Nat. Hist. (8), XI, p. 87, Jan. 1912. Faro, near mouth of Rio Yamundá, Lower Amazon.

Type locality.— Borba, Brazil, near mouth of Rio Madeira.

Geographic description.— Amazonas, from near the mouth of the Rio Madeira westward to an unknown distance, and the valley of the middle portion of the Rio Orinoco; probably also the drainage areas of the Rio Branco and Rio Negro.

Description.— Pelage short and thin, very close and short on the feet and ears. Similar in general coloration to *Guerlinguetus æstuans æstuans* but paler and rather smaller, with a narrower tail. Upperparts finely grizzled light ochraceous buff (Ridgway) and black; eye-ring narrow, pale buff; underparts dark ochraceous orange, most intense on the chest and upper abdomen, somewhat paler posteriorly and much paler on throat; limbs externally like the dorsal surface, internally like the ventral surface; tail above coarsely grizzled with buff and black and broadly edged with buff, varying in intensity in different specimens; underside of tail with the median area finely grizzled with buff and black, the hairs with a broad subapical zone of black, edged with a broad fringe of buff.

The above description is based on 6 specimens from the type region, including specimens from Santarem, Obidos, and the lower Rio Yamundá. A series of specimens from the Rio Caura and middle Orinoco region are similar.

Total length, adult male, 337 mm.; head and body, 166; tail vertebræ, 167; hind foot, c. u., 45. Five specimens from the lower Rio Caura, total length, 342 (329–357); head and body, 169 (155–177); tail vertebræ, 173 (165–178); hind foot, 45 (43–47).

Five skulls (lower Rio Caura region), total length, 44.4 (43.5–47); zygomatic breadth, 25.4 (25–26); interorbital breadth, 14.6 (13.3–15.3); breadth of braincase, 20 (19–21); length of nasals, 12.7 (12–13.5); diastema, 11.1 (11–11.5); maxillary toothrow, 7 (6.4–8).

Specimens examined, 18.— **Brazil**: Santarem, 3 (Am. Mus. 2, Mus. Comp. Zoöl. 1); Obidos, 4 (Mus. Comp. Zoöl.); Faro, Rio Yamundá, 3 (Field Mus. 1, Am. Mus. 2).

Venezuela: Suapure, Rio Caura, 5; Rio Mocho, 1; La Union, 1; El Lagual, 1 (all in Am. Mus.).

Remarks.— Wagner in his later full description of *Sciurus gilvigularis* (*l. c.*, 1850) made his comparison of *gilvigularis* with what is now known as

Sciurus ingrami Thomas, instead of with *S. æstuans* as now restricted, his *æstuans* being the *Sciurus æstuans* of Wied, which is clearly the *Sciurus ingrami* of Thomas, as is evident from his reference to the absence of the "weisse Längslinie längs der Bauchmitte, welche sich bei *Sc. æstuans* findet."

On the other hand, *Sciurus gilvigularis* Wagner is very closely related in all features to true *æstuans*, of which it seems at best only a fairly well differentiated subspecies, with which it is connected geographically through *Sciurus quelchi* and *S. macconnelli* Thomas, which are not very clearly distinguishable from true *æstuans*.

Pelzeln renamed the species *gilviventris*, he preferring, probably for sentimental reason, Natterer's manuscript name to the one previously published by Wagner.

Guerlinguetus æstuans macconnelli (*Thomas*).

Sciurus macconnelli Thomas, Ann. and Mag. Nat. Hist. (7), VIII, p. 148 (footnote), August, 1901.

Type locality.— Near base of Mount Roraima, British Guiana.

Geographic distribution.— Known only from the type locality.

Description.— Like *G. æstuans æstuans* but upperparts possibly browner (brownish olivaceous), and underparts perhaps brighter or deeper orange buff; chin and throat grayish. A buffy postauricular patch, and pelage longer and fuller than in either *æstuans, gilvigularis,* or *quelchii,* in correlation with its different environment.

Type unique, with an imperfect tail (only basal third present), and a fragmentary skull.

Remarks.— Judging from the imperfect type specimen, the only one seen, this may probably rank as a local form of the *æstuans* group, limited probably to the basal portion of Mount Roraima.

Guerlinguetus æstuans quelchii (*Thomas*).

Sciurus quelchii Thomas, Ann. and Mag. Nat. Hist. (7), VIII, p. 147, August, 1901.

Type locality.— Kanuka Mountains, British Guiana, near the Brazilian boundary (59° W., 3° N.); altitude 240 to 300 m.

Geographic distribution.— Known only from Kanuka Mountains in southwestern British Guiana and from the Serro do Lua in northern Brazil.

Description.— Similar to *G. æstuans æstuans* but paler both above and below than either *æstuans* or *gilvigularis.* Upperparts finely grizzled yellowish and black, giving an olivaceous gray effect; underparts pale ochraceous buff, much paler on throat; tail as in *æstuans* but paler; no postauricular patches.

Total length (type, collector's measurements), 343 mm.; head and body, 178; tail vertebræ, 165; hind foot, c. u., 47. The two topotypes are smaller and not quite mature. Skull, type (from Thomas, *l. c.*), total length, 45; zygomatic breadth, 27.5; interorbital breadth, 16; nasals, 10.5 × 6.2; diastema, 11.5; maxillary toothrow, 6.8.

Two adult females from Serra do Lua (near Boa Vista, Amazonas), total length, 355, 362; head and body, 164, 172; tail vertebræ, 181, 190; hind foot, c. u., 46, 46. Skulls of the same specimens, total length, 44.7, 45.6; zygomatic breadth, 26, 25.8; interorbital breadth, 15, 15.8; breadth of braincase, 21, 20.5; length of nasals, 11, 11; diastema, 11, 11; maxillary toothrow, 7, 7.

Specimens examined, 5.— **British Guiana**: Kanuka Mountains, 3, type and topotypes (Br. Mus.). **Brazil**: Serro do Lua (near Boa Vista, Amazonas), 2 (Field Mus.).

Remarks.— This is a pale form, intermediate between *G. æstuans æstuans* and *G. æstuans gilvigularis.*

Guerlinguetus æstuans venustus subsp. nov.

Type, No. 36155, ♀ ad., Boca Sina (altitude 440 ft.), Rio Cunacunumá (southern base of Mount Duida), Venezuela, March 19, 1913; Leo E. Miller.

Pelage and coloration as in *G. æstuans æstuans,* but size smaller. Upperparts grizzled rufous and black, the hairs blackish annulated narrowly with rufous at the tip; underparts orange, chin and throat ochraceous buff; tail coarsely grizzled orange and black, both above and below, the tip black with the ends of the hairs orange; limbs externally like the upperparts, internally like the ventral surface; ears small, clothed with short orange-tipped hairs; postauricular patches absent.

Total length, — ; head and body, 165; tail, — (imperfect); hind foot, c. u., 43. Skull, total length, 42.5; zygomatic breadth, — ; interorbital breadth, 15; breadth of braincase, 21; length of nasals, 14; diastema, 11; maxillary toothrow, 7.3.

Represented only by the type, a young adult female.

This form, in its coloration, closely resembles specimens of true *æstuans* from the coast region of British Guiana, and hence is very unlike the pale *gilvigularis* of the lower Rio Caura region and the middle Rio Orinoco. The only known specimen has the tail imperfect, and the skull is slightly broken.

Guerlinguetus alphonsei alphonsei (*Thomas*).

Sciurus roberti THOMAS, Ann. and Mag. Nat. Hist. (7), XII, p. 463, Oct. 1903. Not *Sciurus thaiwanensis roberti* Bonhote, 1901.

Sciurus alphonsei THOMAS, Ann. and Mag. Nat. Hist. (7), XVIII, p. 442, Dec. 1906. *S. roberti* Thomas, 1903, renamed.

Type locality.— San Lourenço, near Pernambuco, Brazil; altitude 50 m.

Geographic distribution.— Coast region at Pernambuco, Brazil; extent of range unknown.

Description.— Pelage short and close, as in the *æstuans* group. Postauricular patches absent. General color effect above dark olivaceous gray, the hairs blackish tipped with pale fulvous, the hair tips varying in some specimens to ochraceous (as strong as in average *æstuans*); underparts with chest and upper abdomen buff; throat, inguinal and anal regions, inside of limbs and outer borders of ventral surface whitish; tail above at base like the back, apical three fourths blackish with the tips of the hairs white, giving a general dark gray effect, the hairs basally annulated narrowly with black and buff, with a broader subapical zone of black and long white tips; lower surface of tail with the median area grizzled buff and black, and a broad subapical zone of black fringed with white; ears clothed with very short hairs, nearly of the color of the head and body; upper surface of feet with very short hairs, of the same color as the body, as in the *æstuans* group.

Total length, 8 specimens (type and topotypes), collector's measurements, 353 (340–360 mm.); head and body, 181 (165–185); tail vertebræ, 178 (170–190); hind foot, s. u., 44 (42–45).

Skull (type), total length, 46 mm. (Thomas, *l. c.*). The only skull (a topotype) available for measurement at this writing is badly broken, and affords only the following: interorbital breadth, 16; nasals, 13 × 6; palatal length, 22.5; diastema, 11; maxillary toothrow, 8.

Specimens examined, 9.— **Brazil**: San Lourenço, near Pernambuco, 9 (Br. Mus. 8, Am. Mus. 1).

Remarks.— In size, character of pelage, general coloration, and in all other features very similar to the *gilvigularis* phase of the *æstuans* group, except that the ventral surface is much paler and the tail is washed with clear white instead of fulvous.

Guerlinguetus alphonsei paraensis (*Goeldi*).

Sciurus æstuans paraensis GOELDI, Bol. Mus. Goeldi, IV, p. 70, Feb. 1904.

Type locality.— Para, Brazil.

Geographic distribution.— Lower Rio Tocantins; extent of range not known.

Description.— Type and cotype (in British Museum) similar in general features to *G. alphonsei alphonsei,* but more ochraceous, both above and below; but a series of 15 specimens from the immediate vicinity of the type locality presents a wide range of variation in the coloration of both the upper and lower surfaces of the body. The type is strong buff below while the cotype is mostly silvery white below. In other specimens the median area of the ventral surface varies from white tinged with pale buff to pale orange. In some specimens the upperparts are as rufous as in typical *æstuans,* in others grayish olivaceous, indistinguishable in tone from that of average specimens of *alphonsei.* In the more intensely colored specimens the basal portion of the hairs of the tail are more strongly ochraceous than in the paler specimens, in correlation with the general coloration. But the tail appears to be always washed with white as in *alphonsei,* instead of with fulvous as in *gilvigularis,* from which some specimens of the series are otherwise indistinguishable.

Fourteen specimens (11 from Igarape Assú, practically the type locality, and 3 from Cametá, lower Rio Tocantins), measured by the collector: total length, 338 (325–353) mm.; head and body, 170.5 (163–180); tail vertebræ, 171 (158–177); hind foot, s. u., 42 (40–45).

Skull (adult female), total length, 44.2; zygomatic breadth, 26; interorbital breadth, 15.6; breadth of braincase, 20; length of nasals, 12; diastema, 11; maxillary toothrow, 7.

Specimens examined, 23.— **Brazil**: Para, 3, type and 2 cotypes (Br. Mus. 2, Am. Mus. 1); Igarape Assú, 13 (Br. Mus. 11, Field Mus. 2); Cametá, lower Rio Tocantins, 6 (Br. Mus. 3, Field Mus. 1, Am. Mus. 2).

Remarks.— *G. alphonsei paraensis* is closely related to typical *alphonsei,* differing from it slightly and inconstantly in color, and in decidedly smaller size.

In the brief and very inadequate original description of *paraensis* the only comparison made was with the squirrel of the Serra dos Orgãos of southern Brazil (near Rio de Janeiro), referred to as "*Sciurus æstuans* L.," but which was of course the very distinct *S. ingrami* Thomas.

Guerlinguetus ingrami *Thomas.*

Plate IX, Figs. 9, 10; Plate XIII, Figs. 23, 24.

Sciurus æstuans Wied (not of Linné), Beitr. Naturg. Brasilien, II, 1826, p. 431 (southeastern Brazil).— Burmeister, Thiere Brasiliens, I, 1854, p. 146.— Hensel, Abhandl. Akad. Wissens. Berlin, 1872 (1873), p. 26 (not of Linné), Rio Grande do Sul, Brazil.— Allen, Mon. N. Amer. Rodentia, 1877, p. 756 (part, only the specimens from southeastern Brazil); Bull. U. S. Geol. and Georgr. Surv. Territories

(Hayden), IV, No. 4, p. 885, Dec. 11, 1878 (part).— Alston, Proc. Zool. Soc. London, 1878, p. 668 (part). Also, in part, of most authors prior to 1900.

Sciurus ingrami Thomas, Ann. and Mag. Nat. Hist. (7), VII, p. 368, April, 1901; *ibid.*, IX, p. 60, Jan. 1902 (Serro do Mar, Paraná, Brazil).

Type locality.— Tunnel, southern Minas Geraes, Brazil; altitude 1200 m.

Geographic distribution.— Southeastern Brazil, from southeastern part of Bahia to eastern Rio Grande do Sul.

Description.— Pelage thick, rather long and soft; no obvious postauricular patches; tail vertebræ somewhat shorter than head and body.

Upperparts finely grizzled dull buffy and black, giving an olivaceous effect; hairs blackish at base, narrowly annulated near the tip with yellowish and black and tipped with pale yellowish; underparts with the chin and throat white, the chest and belly ochraceous buff, varying in intensity in different specimens, often with a narrow white median line, and the inguinal and scrotal areas whitish; limbs externally like the upperparts; internally the fore limbs are whitish, the hind limbs fulvous; tail long and narrow, the hairs broadly ringed with black and yellow, the tips pale yellow or whitish, the general effect being a coarse grizzle of black and pale yellow on both surfaces; ears rather narrow and pointed, thinly clothed with short fulvous or pale rufous hairs.[1]

Total length (type, collector's measurements), 375 mm.; head and body, 190; tail vertebræ, 185; hind foot, s. u., 44; ear from notch, 21. Twenty-four adults (Br. Mus., 14 males, 10 females), total length, 366 (350–380), head and body, 186 (175–200); tail vertebræ, 184 (170–190); hind foot; s. u., 44 (40–46); ear, 22.5 (20–25).

Skull (type), total length, 49; zygomatic breadth, 28; interorbital breadth, 16; length of nasals, 15; diastema, 13; maxillary toothrow, 7.3 (from Thomas, *l. c.*). Three adult female skulls, Victoria, São Paulo, Brazil (U. S. Nat. Mus.), occipitonasal length, 47 (45.6–48); zygomatic breadth 27.8 (27.5–28.3); interorbital breadth, 15 (14.5–15.5); breadth of braincase, 21.3 (21–22); length of nasals, 13.3 (13–14); diastema, 11.7 (11–12); maxillary toothrow, 7.1 (7–7.4).

Specimens examined, 50.— **Brazil**: Southern Minas Geraes, Paraná, and São Paulo (Robert), 26 (Br. Mus.); Espirito Santo, 1 (Nat. Mus.); Roça Novo, Serro do Mar, Paraná, 1 (Field Mus.); Santa Rita, Bahia, 1 (Mus. Comp. Zoöl.); Cantogallo, and other points near city of Rio de Janeiro, 15 (alcoholic,[2] Mus. Comp. Zoöl.); Alambary, Rio Grande do Sul, 3 (Nat.

[1] Three specimens from Alambary (Victoria), São Paulo, differ from all the others in presenting the peculiar reddish tone of specimens made up from alcoholic material, and the condition of the feet also indicates that this has been the case.

[2] This is the alcoholic series referred by me in 1877 (Mon. N. A. Rodentia, pp. 757, 761, 762) to *Sciurus æstuans* var. *æstuans*, of which measurements are given on p. 761, and on which my description of var. *æstuans* was based. These specimens have been reëxamined in the present connection.

Table VII.—Measurements of Species and Subspecies of Guerlinguetus.

Species, localities, and by whom collected and measured		Number of specimens	Total length	Head and body	Tail vertebræ	Hind foot	Number of specimens	Total length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of nasals	Maxillary toothrow
æstuans	Aver.						4	45.4	26.8	15.3	21.5	12.7	7.2
British Guiana	Min.							44	26	14.4	20	12	7
	Max.							47.3	27	15.6	21	14	7.5
gilvigularis	Aver.	5	342	169	173	45^{c}	7	44.5	25.5	14.6	20	12.7	7
Lower Caura, Ven.	Min.		329	155	165	43		43	24.6	13.3	19	12	6.4
S. M. Klages	Max.		357	177	178	47		47.3	26.5	15.3	20.5	13.5	8
quelchi		1	343	178	165	47	1	45	27.5	16	—	10.5	6.8
alphonsei	Aver.	8	353	181	178	44^{s}							
Pernambuco, Brazil	Min.		340	165	170	42							
A. Robert	Max.		360	185	190	45							
paraensis	Aver.	8	338	171	171	42^{s}	1	44.2	26	15.6	20	12	7
Lower Tocantius, Brazil	Min.		325	163	158	40							
A. Robert	Max.		353	180	177	45							
ingrami	Aver.	24	366	186	184	44^{s}	3	47	27.8	15	21.3	13.3	7.1
Southern Minas Geraes, Brazil	Min.		350	175	170	40		45.6	27.5	14.5	21	13	7
A. Robert	Max.		380	200	190	46		48	28.3	15.5	22	14	7.4

Mus.); São João, Rio Grande do Sul, 1 (Phila. Acad.); "Brazil," 2 (Nat. Mus. 1, Am. Mus. 1).

Remarks.— *Guerlinguetus ingrami* is not closely related to the *G. æstuans* group, from which it differs markedly in the character of the pelage, in coloration and in its much larger size. It has a superficial resemblance to Gray's *Macroxus leucogaster* in coloration and in character of pelage, but differs widely from it in the structure of the molar teeth, and in having 8 mammæ instead of only 6. It is less nearly related to the "*cuscinus*" group.

Genus **Hadrosciurus** gen. nov.

Text Fig. 9 (p. 163); Plate XII, Figs. 4–6; Plate XIV, Figs.7, 8.

Type, *Sciurus flammifer* Thomas.

Size large, tail very long and bushy, about 53 % of the total length; general form strong and heavy; mammæ, 8.

Premolars, $\frac{1}{1}$. Skull moderately broad and heavy; rostrum short, with short broad nasals, their length about 20 % of the total length of the skull, and about 66 % of the interorbital breadth; dorsal outline flattened, nearly as in *Urosciurus* and *Simosciurus;* zygomatic arches convex, broadest opposite the postorbital processes; malar strongly developed, expanded at the middle to form a prominent superior process; dentition heavy, the molariform series broader and heavier than in any other South American squirrel; postorbital processes heavily developed. In general effect the skull is strong and massive, but its breadth is relatively less than in typical *Sciurus.*

Geographic distribution.— Valley of the Orinoco near mouth of Rio Caura. Extent of range not known. (See Map, p. 300.)

Remarks.— In external appearance *Hadrosciurus* has a general resemblance to *Urosciurus,* but the tail is heavier than in most of the species of that genus, in which respect it is only equalled in *U. duida.* The essential cranial characters are the heavy ossification, the relatively great breadth of the zygomatic arches, and the broad heavy malar with its prominent superior process. It resembles *Simosciurus* in the shortness of the rostrum, but not in other general features. In cranial characters it contrasts strongly with the typical forms of *Urosciurus.* The usual crenulation of the outer crown border of the maxillary teeth is well indicated on m^{1-3} in unworn-teeth, except that the parastyle is feebly developed.

Remarks.— The only known representative of *Hadrosciurus* is *Sciurus flammifer* Thomas, a striking species in its external features and well distinguished from all its allies by cranial peculiarities.

Hadrosciurus flammifer (*Thomas*).

Text Fig. 9 (p. 163); Plate XII, Figs. 4–6; Plate XIV, Fig. 7, 8.

Sciurus flammifer Thomas, Ann. and Mag. Nat. Hist. (7), XIV, p. 33, July, 1904.— Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 340, Oct. 8, 1904 (La Union, El Llagual, and Suapure, Venezuela); *ibid.*, XXVIII, p. 146, May 27, 1910 (Rio Mocho, Venezuela); *ibid.*, XXX, p. 254, Dec. 2, 1911 (El Llagual).

Type locality.— La Union, Caura district, Middle Orinoco, Venezuela.

Geographic distribution.— Orinoco basin, from at least Ciudad Bolivar to Suapure.

Description.— Pelage long and coarse with very little underfur. Head and ears bright rufous, the ears with a postauricular patch of soft, light rufous hairs; rest of upperparts grizzled yellow and black, darkening on the lower back and rump to mixed rufous and black; lips and chin yellow orange; rest of underparts clear white, separated from the upperparts by an orange lateral line; outside of limbs bright rufous, inside white like the ventral surface; upper surface of feet orange rufous, lighter than the limbs; basal third of tail black narrowly fringed with orange red; rest of the tail (which is broad and bushy) orange on both surfaces.

The above description is based on a topotype, which agrees in every particular with the type. Five other specimens from La Union (and hence topotypes) are melanistic. In four of them the pattern of coloration is the same as in the type, but the head, lower back and limbs are duller, darker rufous; the rest of the upperparts is a grizzle of pale yellow and black; the underparts are dusky brown with a rufescent tinge, but no two of them are quite alike; tail brownish black (quite black at base) with a slight wash of fulvous, the hairs annulated broadly with brownish black and fulvous, with fulvous tips. The remaining specimen is both albinistic and melanistic, the head and feet being mixed white and rufous, and the ventral surface white with scattered black hairs. Of four specimens from El Llagual three are melanistic and one is like the type, but no two of the melanistic specimens agree in color. A single specimen from Ciudad Bolivar is also melanistic, while six from Suapure are like the type of the species. Of the 17 specimens in the American Museum collection 8 are normal and 9 are melanistic.

Total length (type, ex Thomas, *l. c.*), 598 mm.; head and body, 285; tail vertebræ, 313; hind foot (s. u.), 65, c. u., 70. Ten specimens (La Union and Suapure), total length, 580 (540–610); head and body, 274 (254–289); tail vertebræ, 310 (280–320); hind foot (c. u.), 66.5 (64–67).

Skull (5 topotypes), total length, 65.5 (64–67); zygomatic breadth, 38

(37–39); interorbital breadth, 23 (22–25); postorbital breadth, 20.5 (19–21); breadth of braincase, 26.5 (26–27); nasals, 20.1 × 9.2 (19–21.5 × 9–10); diastema, 18; maxillary toothrow, 10.5 (10–11).

Specimens examined, 17.— **Venezuela**: La Union, 8 (Br. Mus. 2, type and paratype; Am. Mus. 6); El Llagual, 2 (Am. Mus.); Ciudad Bolivar, 1 (Am. Mus.); Rio Mocho, 1 (Am. Mus.); Suapure, 5 (Am. Mus.).

Remarks.— The geographic relationship of *Hadrosciurus flammifer* to the *Urosciurus* group is little known. *U. duida* occurs on the upper reaches of the main Orinoco, the *U. igniventris* group on the Rio Negro and in the Cundinamarca and Caquetá districts of Colombia, to which *flammifer* is much more nearly related than to *U. tricolor* or *U. duida*.

Genus **Urosciurus** gen. nov.

Text Figs. 10, 16 (pp. 164–165); Plates X and XI; Plate XIV, Figs. 1–6.

Type, *Sciurus tricolor* Pœppig.

Size large; tail long, broad, and bushy, the vertebræ about 50 to 52 % of the total length; mammæ, 8; pelage usually thin and short, often very thin on the ventral surface.

Premolars, $\frac{1}{1}$. Skull long and narrow, of medium depth (about 36 % of total length at m^3), and only moderately convex, the mid-dorsal outline nearly straight; length of nasals 31 to 33 % of total skull length; zygomata evenly convergent anteriorly, the breadth of the skull at m^1 being much less than at the posterior border of the zygomatic fossæ (about 50 % instead of 56 % of total skull length); malar weak, narrow, superior process slightly developed; dentition weak; molars with the cusps on outer border small and low, the intervening cusplets nearly suppressed; lower incisors long, in correlation with the long rostrum.

Geographic distribution.— Drainage basins of the upper Orinoco and middle and upper Amazon. (See map, p. 300.)

Remarks.— The special features of *Urosciurus* are the long, broad tail, which appears to reach its maximum development in *U. duida* (*q. v.*); the gradually anteriorly converging outlines of the skull, from the posterior border of the zygomatic fossæ to the end of the long narrow rostrum; the depressed dorsal outline, the general narrowness of the skull in proportion to its length, and the weak, simple dentition. The genus includes *U. tricolor, pyrrhonotus, igniventris, duida*, and *langsdorffii*, with their respective subspecies. The nasals vary in their posterior extension, reaching further back in *tricolor* than in the *igniventris* and *duida* groups. *U. langsdorffii* is aberrant, but seems better placed here than in any of the other generic groups here recognized, and not sufficiently differentiated to warrant separation from the typical forms of *Urosciurus*. It also occupies a different faunal area, its range being outside and south of the great Amazonian forest region, which constitutes the principal range of the genus.

Species and Subspecies of Urosciurus, with type localities and statement of number of specimens examined.

Urosciurus tricolor (Pœppig). Maynas, near junction of Huallaga and Marañon Rivers. Specimens examined, 3.

Urosciurus duida (Allen). Southern base of Mount Duida, Venezuela. Specimens examined, 3.

Urosciurus igniventris igniventris (Wagner). Maribitanos, Upper Rio Negro, Brazil. Specimens examined, 5.

Urosciurus igniventris tœdifer (Thomas). Bogotá district, Colombia. Specimens examined, 1.

Urosciurus igniventris cocalis (Thomas). Near junction of Rio Coco and Rio Napo, Ecuador. Specimens examined, 2.

Urosciurus igniventris zamoræ (Allen). Zamora, Ecuador. Specimens examined, 1.

Urosciurus pyrrhonotus pyrrhonotus (Wagner). Borba, Brazil, near mouth of Rio Madeira. Specimens examined, 1.

Urosciurus pyrrhonotus castus (Thomas). Chimate, Bolivia. Specimens examined, 1.

Urosciurus langsdorffii langsdorffii (Brandt). "Brasilia" = Cuyabá, Matto Grosso, Brazil. Specimens examined, 16.

Urosciurus langsdorffii urucumus (Allen). Urucum, Matto Grosso, Brazil. Specimens examined, 11.

Urosciurus langsdorffii steinbachi (Allen). Sta. Cruz de la Sierra, Bolivia. Specimens examined, 5.

Key to the Species and Subspecies of Urosciurus.

Skull with rostrum very long and narrow.

Upperparts dark brown or blackish, washed with ochraceous; underparts pale yellowish..*tricolor* (p. 269)

Upperparts lighter, washed with yellowish gray; underparts dark ferruginous *duida* (p. 270)

Skull with rostrum shorter.

Upperparts heavily washed with ochraceous; head ochraceous rufous; underparts ferruginous.

Tail with basal third deep black, rest heavily fringed with reddish orange, concealing the black basal portion of the hairs. *igniventris* (p. 271)

Tail with much less black, otherwise similar to *igniventris*. *tædifer* (p. 272)

Upperparts with median area from crown to base of tail blackish; underparts pale ochraceous buff .... *cocalis* (p. 273)

Similar in general coloration but much smaller .... *zamoræ* (p. 274)

Upperparts posteriorly washed heavily with reddish; tail as in the *igniventris* group.

Underparts pale yellowish .... *pyrrhonotus* (p. 275)

Underparts white .... *castus* (p. 276)

Upperparts grizzled with pale yellowish and dusky; underparts ochraceous buff. *langsdorffii* (p. 276)

General coloration above darker, with much more black in the tail; size smaller .... *urucumus* (p. 278)

General coloration paler; size larger .... *steinbachi* (p. 279)

Urosciurus tricolor (*Pœppig*).

Text Figs. 10, 16 (pp. 164, 165); Plate X, Figs. 1–3.

Sciurus tricolor Tschudi (ex Pœppig), Fauna Peruana, I, Therologie, 1844, pp. 156, 160, pl. xi, animal.— Pœppig, in Tschudi, *op. cit.*, p. 157, footnote.— Wagner, Abhandl. K.-B. Akad. Wissen. München, V, 1850, p. 279.— Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 137, July, 1900 (mouth of Rio Coco, Upper Rio Negro).— Osgood, Field Mus. Nat. Hist., Zoöl., X, No. 12, p. 154, April 20, 1914 (Lagunas and Puerto Arturo, Huallaga River, Peru).

? *Sciurus fumigatus* Gray, Ann. and Mag. Nat. Hist. (3), XX, Dec. 1867, p. 428 ("Upper Amazon"). "May possibly be referable to *S. tricolor*, but its determination must always remain somewhat doubtful." — Thomas, *l. c.*

? *Sciurus brunneoniger* Gray, Ann. and Mag. Nat. Hist. (3), XX, p. 429, Dec. 1867. Also "a member of the present group, but is not like any properly localized species I have seen."— Thomas, *l. c.*

Type locality.— Maynas, in the angle between the Lower Huallaga and the Marañon.

Geographic distribution.— Northeastern Peru.

Description.— Pelage short, thin and harsh, nearly without underfur; ventral surface very thinly clothed. Mammæ 8 (not 6 as stated by Tschudi).

Upperparts dark reddish or yellowish brown, the hairs black, slightly tipped and subapically narrowly annulated with ochraceous orange or ochraceous red (in different specimens); top of head blackish, darker than the back; front and sides of head orange with a short narrow black nasal stripe; fore limbs externally bright rufous, hind limbs dark rufous; underparts and inner surface of hind limbs varying in different specimens from rufous to yellowish white; tail above for the basal third black more or less grizzled with rufous, rest of upper surface washed with orange, the basal three fourths of the hairs black, the apical fourth orange; under surface of tail at extreme base grizzled rufous and black, beyond the basal inch black to the tip, broadly fringed for the distal two thirds with orange, including the terminal hairs.

Total length (No. 19672 Field Mus., ♀ ad., Yurimaguas, Peru), 533 mm.; head and body, 273; tail vertebræ, 260; hind foot, 69. Skull (same specimen), total length, 69; zygomatic breadth, 38.7; interorbital breadth, 21; postorbital breadth, 19; breadth of braincase, 24; nasals, 22 × 8; diastema, 21; maxillary toothrow, 10. Another specimen (No. 19673 Field Mus., ♀ ad., Lagunas, Peru), total length, 70.3; zygomatic breadth, 39.3; interorbital breadth, 21; postorbital breadth, 20; breadth of braincase, 24; nasals, 20.5 × 10; diastema, 21; maxillary toothrow, 10.

Specimens examined, 3.— **Peru**: Yurimaguas, 1, and Lagunas, 1 (Field Mus.); Rio Madre de Dios, 1 (Mus. Comp. Zoöl.).

Remarks.— In common with the other large squirrels of South America *Sciurus tricolor* presents a wide range of individual variation, especially in the color of the ventral surface, which in some specimens is deep rufous, in others yellowish white or nearly clear white. *S. tricolor* differs from the large squirrels of the *langsdorffii-igniventris-pyrrhonotus* group in the form of the skull, which is relatively longer and narrower, with a relatively longer and narrower rostrum, a longer diastema, and longer lower incisors.

Urosciurus duida (*Allen*).

Text Fig. 11 (p. 164); Plate X, Figs. 4–6; Plate XIV, Figs. 1, 2.

Sciurus duida Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 594, Oct. 8, 1914.

Type locality.— Rio Cunucunumá, southern base of Mount Duida, Venezuela; altitude 700 feet.

Geographic distribution.— Known only from the type locality.

Description.— "Size large, pelage long and soft with abundant underfur; tail very broad. Upperparts (type) blackish washed lightly with pale cream color, the hairs brownish black slightly tipped with cream color, the general surface effect yellowish gray on a brownish black ground color; top of head darker brown, the hairs minutely tipped with pale rufous; sides of head cinnamon brown; lower back and rump scarcely darker than the middle of the back but the hairs are tipped with very pale rufous instead of cream color; underparts dark ferruginous to the base, the upper chest and throat paler; fore limbs and feet intense deep rufous; hind limbs externally chestnut grizzled with black, internally dark ferruginous; upper surface of hind feet reddish orange; tail above black for about the basal fifth, rest of the upper surface washed lightly with orange yellow, the black subbasal portion of the hairs strongly visible at the surface, the base of the hairs annulated with pale buff; tail below almost wholly intense black for the proximal half, the distal half grizzled black and pale orange yellow, black predominating, and narrowly fringed with pale orange yellow. One of the two topotypes is like the type, in the other the hair tips of the upperparts and the fringe of the tail are a little deeper tone of yellow.

"Total length (type), 560 mm.; head and body, 270; tail vertebræ, 290; hind foot, 65. The lateral hairs of the tail are fully 75 mm. long, and when the hairs are directed laterally give a breadth of fully 6 inches,— about one third greater than in *S. tricolor* or in any member of the *langsdorffii-igniventris-pyrrhonotus* group.

"Skull (type), total length, 66; zygomatic breadth, 38; interorbital breadth, 20; postorbital breadth, 19.3; breadth of braincase, 25; nasals, 22 × 8.2; diastema, 19; maxillary toothrow, 10. Rostrum relatively long and narrow."— Allen, *l. c.*

Specimens examined, 3.— **Venezuela**: Southern base of Mt. Duida, type and 2 topotypes (Am. Mus.).

Remarks.— In the form of the skull *Sciurus duida* closely resembles *S. tricolor*, especially in the narrow, slender, and relatively long rostrum, but it has no near resemblance to that species in coloration or texture of pelage, in which it most resembles the *igniventris* group, with which, however, the form of the skull denotes no close relationship. A striking feature of this species is its magnificent tail, which is fully one third broader than that of any other South American squirrel.

Urosciurus igniventris igniventris (*Wagner*).

Plate XIV, Figs. 3, 4.

Sciurus igniventris Wagner (ex Natterer, MS.), Wiegmann's Arch. f. Naturg., 1842, I, p. 360; Abhandl. math.-phys. Classe, K.-B. Akad. Wissen. München, V, 1850, p. 275.— Allen, Mon. N. Amer. Rodent., 1877, pp. 768–773 (part, only the reference to *S. igniventris* Wagner).— Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 137, July, 1900, part (Nericagua and Munduapo, Upper Orinoco; not the Bogotá specimens = *S. i. tædifer* Thomas, 1903).

Sciurus morio Wagner, Abhandl. math.-phys. Classe, K.-B. Akad. Wissen. München, V, 1850, p. 275 (a melanism of *S. igniventris*).

Sciurus variabilis Allen, Mon. N. Amer. Rodentia, 1877, p. 768, part.— Alston, Proc. Zool. Soc. London, 1878, p. 665, part.

Type locality.— Maribitanos, Upper Rio Negro, Brazil.

Geographic distribution.— Upper Rio Negro and Upper Orinoco, west in Colombia to base of Eastern Andes.

Description.— Upperparts of body grizzled ochraceous and black, the hairs black broadly tipped with ochraceous; top of head, limbs, and whole ventral surface deep red; tail above at base black, the hairs tipped with orange, rest of upper surface orange; tail below deep black for the basal third, and medially the hairs are black at base nearly to the end of the vertebræ, the tips orange or reddish orange, which toward the end of the tail nearly or quite conceal the black.

Total length (3 adult specimens from Florencia and 1 from Murelia, collector's measurements), 530 (520–540 mm.); head and body, 270 (260–280); tail vertebræ, 260 (250–270); hind foot, c. u., 60.

Skull (1 specimen from Murelia), total length, 63; zygomatic breadth, 37; interorbital breadth, 23; postorbital breadth, 21; breadth of braincase, 26.3; nasals, 19 × 9.6; maxillary toothrow, 9.8.

Specimens examined, 5.— **Colombia**: Florencia, 4; Murelia, 1 (all Am. Mus.); also a number of specimens in the British Museum, with which the above were compared, but which I neglected to record definitely in my notes).

Remarks.— The specimens here recorded from Florencia and Murelia appear to be positively referable to true *igniventris,* which differs from *S. igniventris tœdifer* Thomas as indicate below.

Urosciurus igniventris tœdifer (*Thomas*).

Sciurus igniventris Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 137, July, 1900 (part, the "Bogotá" specimens only).

Sciurus igniventris tœdifer Thomas, Ann. and Mag. Nat. Hist. (7), XI, p. 487, May, 1903.

Type locality.— "Sabaña Grande, near Bogotá, Colombia." As Sabaña Grande is open pampas country, it can hardly be the true type locality of this large forest squirrel. A single specimen in the American Museum, which agrees perfectly with Thomas's description of *tœdifer,* is from Buenavista (altitude 4500 feet), about 50 miles southeast of Bogotá.

Geographic distribution.— Known only from the vicinity of Bogotá.

Description.— Similar to *S. igniventris igniventris,* except that there is less black at the base of the tail, and very much less on the under side of the tail beyond the black basal area.

Total length (1 specimen, collector's measurements, Buenavista), 505 mm.; head and body, 259; tail vertebræ, 246; hind foot (c. u.), 67.

Skull, total length, 63; zygomatic breadth, 37; interorbital breadth, 22; postorbital breadth, 21; breadth of braincase, 27; nasals, 19 × 9; diastema, 17; maxillary toothrow, 10.

Specimens examined, 1.— **Colombia**: Buenavista (alt. 4500 ft.), 1 (Am. Mus.).

Remarks.— A rather weakly differentiated form of *igniventris*, differing from it in having less black in the tail. Known, however, at present from only two specimens, the type in the British Museum, from near Bogotá, and a specimen from Buenavista in the American Museum.

Urosciurus igniventris cocalis (*Thomas*).

Sciurus cocalis Thomas, Ann. and Mag. Nat. Hist. (7), VI, p. 138, July, 1900.— Osgood, Field Mus. Nat. Hist., Zoöl., X, No. 12, p. 153, April 20, 1914 (Yurimaguas, Huallaga River, Peru).

Type locality.— Mouth of Rio Coco, upper Rio Napo, Ecuador.

Geographic distribution.— Upper parts of the tributaries of the Rio Marañon, from the Rio Coco south at least to the Rio Huallaga. Limits of range not known.

Description.— Similar in size and in general coloration to *Urosciurus igniventris igniventris*, but the light tips of the hairs are greatly reduced in extent or quite absent, leaving the black strongly predominant, and the underparts are pale yellow instead of red. Head orange on the sides, red finely varied with black on the top, continuous with the same color on nape, shoulders and flanks (the tipping of the hairs varying in color in different specimens from orange to dark chestnut red); back posteriorly nearly or wholly black, the black extending also over the basal third of the upper surface of the tail; underparts nearly uniform ochraceous buff; fore limbs and feet pale orange; hind limbs chestnut, feet orange red; ears red, paler at base, with a large postauricular patch of soft orange yellow hairs; tail above wholly black at base, the rest at surface orange, the hairs broadly zoned with black subbasally, the black zone visible both above and below on slight displacement of the hairs at the surface, and gradually narrowing on the apical half of the tail.

Total length (2 adult females), 569, 559 mm.; head and body, 266, 276; tail vertebræ, 295, 283; hind foot, c. u., 68, 64.

Skull (same specimens), total length, 63, 62; zygomatic breadth, 38, 37; interorbital breadth, 22.2, — ; postorbital breadth, 20, — ; breadth of braincase, 25, 25; nasals, 20 × 9.5, 19 × 9; diastema, 17; maxillary tooth-row, 10, 10.

Specimens examined, 2.— **Peru**: Yurimaguas, mouth of Rio Huallaga (alt. 600 ft.), 2 (Field Mus.).

Remarks.— At present *Sciurus cocalis* is known from very few specimens and from two localities, mouth of the Rio Coco (type locality), and mouth of the Rio Huallaga (Osgood). It is less different from *igniventris* than are a number of the subspecies of the *gerrardi* group from each other.

Urosciurus igniventris zamoræ (*Allen*).

Sciurus igniventris zamoræ Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 594, Oct. 8, 1914.

Type locality.— Zamora, Ecuador; altitude 2000 feet.

Geographic distribution.— Known only from the type locality.

Description.— "Similar to *S. igniventris cocalis* but much smaller, with the whole under surface of the tail black except a narrow orange red border on the apical two thirds, and other color differences.

"Upperparts blackish, the hairs tipped with chestnut, very minutely over the dorsal region, more broadly on the flanks, and with fine punctations of yellow on the head; postauricular patches orange; underparts nearly uniform pale ochraceous buff, brighter on inside of fore and hind limbs and laterally; tail above dull black for the basal third, the hairs strongly tipped with chestnut, the rest bright orange, the hairs black subbasally for half their length with long orange tips; lower surface of tail grizzled red and black for the proximal fourth, the red predominating, followed by a broad band of black extending nearly to the tip of the tail and narrowly fringed with orange, black thus prevailing from near the base, to the tip, with an outer border of orange, the terminal hairs black for half their length; fore limbs and feet externally light yellow; hind limbs externally chestnut, the feet pale orange.

"Total length (in skin), 490 mm.; head and body, 260; tail vertebræ, 230; hind foot, c. u., 61. (The collector's measurements give the total length as 520, which is obviously erroneous, and the tail as 230).

"Skull, total length, 59; zygomatic breadth, 33.5; interorbital breadth, 19; postorbital breadth, 20.5; breadth of braincase, 25; nasals, 16.3 × 9; maxillary toothrow, 9.2. The type is an old male with much worn teeth.

Specimens examined, 1, the type.

Remarks.— "*Sciurus igniventris zamoræ* differs from *cocalis,* its nearest geographical representative, in much smaller size, the total length being about 60 mm. less than in *cocalis,* the total length and zygomatic breadth of the skull 3.5 mm. less, and other cranial measurements proportionally less. While the general coloration is similar to that of *cocalis* there are many minor differences, aside from the color of the tail, which differs in the presence of a much larger amount of black on the under surface. It thus differs in coloration from true *igniventris* as *tædifer* does, but in the opposite direction, having much more black in the tail instead of less. In addition to this is the marked difference in size, *zamoræ* being much smaller than any other subspecies of the *igniventris* group. The type locality of *zamoræ* is 250 to 300 miles from any known locality of *cocalis* and in a quite different environment. Either *zamoræ* is a small form of *cocalis*, or the type must be construed as a dwarf, and its color differentiation as an individual aberration, although it has the appearance of being in every way a normal adult."— Allen, *l. c.*

Urosciurus pyrrhonotus pyrrhonotus (*Wagner*).

Plate XI, Figs. 1–3.

Sciurus pyrrhonotus Wagner (ex Natterer MS.), Wiegmann's Arch. f. Naturg., 1842, I, p. 260; Abhandl. math.-phys. Cl. K.-B. Akad. Wissen. München, V, 1850, p. 277.— Pelzeln, Verhandl. K.-K. zool.-bot. Gesells. Wien, XXXIII, Beiheft, 1883, p. 60.

Type locality.— Borba, Brazil, near mouth of Rio Madeira.

Geographic distribution.— Interior of Brazil, from mouth of Rio Madeira southwestward. Exact range unknown.

Description.— Upperparts rust red, paler and more orange red anteriorly, passing into dark fiery red posteriorly; top of head darker; ears red; underparts whitish yellow or ochraceous yellow, lighter on throat and chest, or irregularly patched with white; fore limbs and feet bright red, hind feet orange red; tail above with the basal fourth black, rest of upper surface heavily washed with orange red, the hairs black for their basal half or two thirds, black showing more or less through the red tips; under surface of tail black for the basal third, beyond which the median area is black broadly edged with red, the black decreasing and the red increasing in amount toward the tip, the terminal hairs being black for the basal two thirds and tipped with red.

Total length (1 specimen, ♂ ad., from Calama, on Rio Madeira at mouth of Rio Gy-Paraná), 540 mm.; head and body, 270; tail vertebræ, 270; hind foot, c. u., 72.

Skull (same specimen), total length, 65; zygomatic breadth, 37; interorbital breadth, 22; postorbital breadth, 19; breadth of braincase, 23.6; nasals, 18 × 8; diastema, 18; maxillary toothrow, 10.

Specimens examined, 1.— **Brazil**: Calama, Rio Madeira at mouth of Rio Gy-Paraná (Am. Mus., Roosevelt Exped.).

Remarks.— The only specimen available for examination was taken on the Lower Rio Madeira not far from the type locality.

Sciurus pyrrhonotus and *Sciurus igniventris* are apparently representative forms of the same species, for which the name *igniventris* has priority of place on the same page. In size and in pattern of coloration there is a close similarity, the differences being the different shades of color that make up the different areas of the pattern. The rostral part of the skull, however, is much narrower in *pyrrhonotus* than in *igniventris,* with much narrower and shorter nasals.

Urosciurus pyrrhonotus castus (*Thomas*).

Sciurus pyrrhonotus THOMAS, Ann. and Mag. Nat. Hist. (7), VI, p. 139, July, 1900, part (Yungas and Missiones, upper Marmoré, Bolivia).

Sciurus castus THOMAS, Ann. and Mag. Nat. Hist. (7), XI, p. 488, May, 1903.

Type locality.— Chimate (altitude 700 m.), Bolivia, long. 68° W., lat. 15° S., on the upper Rio Bene.

Geographical distribution.— Known only from the Department of Yungas, upper Rio Bene, Bolivia.

Description.— Similar to *Sciurus pyrrhonotus,* but ventral surface and inside of limbs "pure sharply defined white."

Specimens examined, 1.— "**Brazil**," 1 (Field Mus.).

Remarks.— A specimen in the Field Museum of Natural History (No. 8283), from "Brazil" (bought of E. Gerrard), agrees well with the description of *castus,* except that the ventral surface and inside of the limbs, throat, chest, and greater part of abdomen (especially medially) are clear white, but the pelage is very thin, the skin showing through the hairs; the sides of abdomen posteriorly and the inside of the hind limbs are pale yellow. The basal third of the tail is mixed rufous and blackish, in general effect a little darker than in true *pyrrhonotus.*

Urosciurus langsdorffii langsdorffii (*Brandt*).

Plate XI, Figs. 4–6.

Sciurus langsdorffii BRANDT, Mém. Acad. Sci. St. Pétersbourg (6), Math. Phys. et Nat., III, pt. 2, 1835, p. 425, pl. xi, animal and skull ("Brasilia").— WAGNER, Suppl. Schreber's Säuget., III, 1843, p. 183; Abhandl. K.-B. Akad. Wissen. München, V, 1850, p. 273, Cuyabá, Matto Grosso, Brazil.— THOMAS, Proc. Zool. Soc. London, 1903 (April 1, 1904), p. 237 (Chapada, Matto Grosso, Brazil).

Sciurus variabilis ALLEN, Mon. N. Amer. Rodentia, 1877, p. 768, part; Bull. U. S. Geol. and Geogr. Survey Terr. (Hayden), IV, No. 2, p. 884, part. (The status of *S. langsdorffii* discussed on pp. 769, 770).— ALSTON, Proc. Zool. Soc. London, 1878, p. 665, part.

Sciurus variabilis var. *langsdorffii* COPE, Amer. Nat., Feb. 1883, p. 135 (Chapada, Matto Grosso).

Type locality.— "Brasilia" = Cuyabá, Matto Grosso, Brazil.

Brandt, in describing *langsdorffii,* gave no definite type locality. Wagner (1850, *l. c.*) found that Natterer's specimens from Cuyabá, Matto Grosso, were like Brandt's type, and restricted the name *langsdorffii* to the Matto Grosso form. Later Thomas (1903, *l. c.*) confirmed this action, stating that a series of specimens from Chapada (only a few miles from Cuyabá), Matto Grosso, represents "the true *S. langsdorffii.*" Cuyabá, Matto Grosso, may therefore be taken as the type locality of the species.

Geographic distribution.— Southwestern Brazil (Matto Grosso). Boundaries of range not known.

Description.[1]— Upper surface of head grizzled yellowish rufous and black, front and sides of head nearly clear rufous; upperparts of body from nape to rump grizzled yellowish and dusky, the hairs dusky with pale yellowish tips; rump and basal fourth to third of tail grizzled dark rufous (or chestnut) and black; underparts nearly uniform ochraceous buff, in some specimens with a narrow line of small spots of white on the chest; fore limbs and feet externally grizzled pale yellow and dusky, internally orange buff, deeper colored than the ventral surface; hind limbs externally reddish chestnut, feet paler; upper surface of tail for basal third grizzled rufous and black, more or less in contrast with the back; rest of the tail above orange, the hairs black at base with long orange tips, the black showing through when the hairs are disarranged; lower surface of the tail similar to the upper, the hairs black basally and tipped with orange, the black not wholly concealed and in some specimens strongly visible on the median line of the proximal half.

External measurements of 2 Chapada specimens are as follows: Total length, 510, 504 mm.; head and body, 260, 250; tail vertebræ, 257, 254; hind foot (dry skin), 55, 56.

Skull (8 specimens, Chapada), total length, 62 (60.8–64); zygomatic breadth, 36.4 (35–38); interorbital breadth, 20.4 (20–21); postorbital breadth, 18.9 (18.5–19); breadth of braincase, 23.8 (23.3–24.3); nasals, 18.5 × 8.3 (17.3–19 × 7.8–8.7); diastema, 18 (17.5–19); maxillary toothrow, 9.8 (9.3–10).

Specimens examined, 16.— **Brazil**: Chapada, Matto Grosso, 15 (Nat. Mus., 4; Acad. Nat. Sci. Philadelphia, 10, Am. Mus. 1, coll. H. H. Smith); "South America," 1 (Nat. Mus.).

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[1] Based on Chapada, Matto Grosso, specimens, collected by H. H. Smith.

Urosciurus langsdorffii urucumus (*Allen*).

Sciurus langsdorffii urucumus Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 595, Sept. 8, 1914.

Type locality.— Urucum, Rio Paraguay (at mouth of Rio Tacuary), Matto Grosso, Brazil; altitude 400 feet.

Geographic distribution.— Known only from the vicinity of the type locality, in southwestern Matto Grosso, Brazil.

Description.— "Similar in general to *S. langsdorffii langsdorffii,* but much smaller and darker colored, with much blacker tail. Upperparts dusky brown, the hairs brownish black minutely tipped with yellowish; nose and front of head pale orange with a narrow median stripe of black on the nose; lower back and rump with tips of the hairs inclining to dark rufous; ears externally blackish edged with rufous; postauricular patch of soft rufous hairs conspicuous; underparts nearly uniform ochraceous buff; fore limbs and feet externally grizzled buff and black; hind limbs externally light chestnut, feet grizzled dark rufous and black; tail above for the basal fourth intense black, usually a few of the hairs tipped with chestnut; rest of the upper surface of tail pale orange, the hairs black for the greater part of their length, tipped with pale orange, through which the black basal portion of the hairs is more or less visible; tail below for the basal third or more, and medially often nearly to the end, intense black, fringed with orange for the apical two thirds and at the tip.

"Total length (type, collector's measurements), 500 mm.; head and body, 260; tail vertebræ, 260; hind foot, s. u., 60, c. u., 63. Six adults (all topotypes), total length, 502 (490–530), head and body, 251 (240–260); tail vertebræ, 250 (230–260); hind foot, c. u., 60.5 (60–63).

"Skull (type), total length, 57; zygomatic breadth, 35.2; interorbital breadth, 19; postorbital breadth, 18; breadth of braincase, 23.2; nasals, 17 × 7; diastema, 16; maxillary toothrow, 8.5. Seven skulls (type and 6 topotypes), total length, 59 (57–61); zygomatic breadth, 35 (34.6–36); interorbital breadth, 19.6 (19–21); postorbital breadth, 18.3 (18–19); breadth of braincase, 23.4 (22.6–24); nasals, 18.3 × 7.4 (17.5–19 × 7–8); diastema, 16 (16–18); maxillary toothrow, 8.8 (8.3–9.2)." — Allen, *l. c.*

Specimens examined, 11.— **Brazil**: Urucum, 7; Tapirapoan, 4 (Am. Mus., Roosevelt Exped.).

Remarks.— The type locality is about 350 miles south of Cuyabá, the type locality of *langsdorffii.* While the external measurements (on the basis of collectors' measurements) of *urucumus* seem to slightly exceed those of either *langsdorffii* or *steinbachi,* the skulls are markedly smaller, with narrower braincase and weaker dentition, and the total length of the skull is 3 to 4 mm. less, with corresponding differences in all other measurements. The coloration in *urucumus* is much darker than in either *langsdorffii* or *steinbachi*, the light tips to the hairs being shorter and paler, while the black in the tail is more intense and greatly increased in area.

Urosciurus langsdorffii steinbachi (*Allen*).

Sciurus langsdorffii steinbachi Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 596, Sept. 8, 1914.

Type locality.— Santa Cruz de la Sierra, Bolivia.

Geographic distribution.— Known only from the type locality.

Description.— "Differs from *S. langsdorffii langsdorffii* in much paler coloration throughout, the hairs of upperparts being slightly tipped with pale yellow instead of heavily tipped with orange; the top of the head and nape slightly washed with yellow instead of orange rufous; nose and sides of head dull yellowish instead of deep rufous; thighs rufous instead of chestnut; underparts pale yellow instead of ochraceous yellow, and tail fringed with a lighter shade of yellow.

"Total length (type, collector's measurements), 505 mm.; head and body, 250; tail vertebræ, 255; hind foot, 55; ear, 32. Five specimens (including type), total length, 491 (475–505); head and body, 254 (250–260); tail vertebræ, 235 (225–255); hind foot, s. u., 55 (55–55).

"Skull (type), total length, 63; zygomatic breadth, 37; interorbital breadth, 23; postorbital breadth, 19; breadth of braincase, 23; nasals, 20 × 9; maxillary toothrow, 9. Five skulls (including type), total length, 60.6 (60.2–61); zygomatic breadth, 36 (35–37); interorbital breadth, 20.6 (20–21); postorbital breadth, 18.6 (18–19); breadth of braincase, 23.6 (23–24); nasals, 18.3 × 7.9 (17.8–19.8 × 7.6–8); maxillary toothrow, 9 (9–9.2)." — Allen, *l. c.*

Specimens examined.— **Bolivia**: Santa Cruz de la Sierra, 5 (Carnegie Mus., Pittsburgh).

Remarks.— Agrees closely in size and in general coloration with subspecies *langsdorffii*, but is readily distinguishable by the absence of the strong rufous color of the head present in both *langsdorffii* and *urucumus*. The type locality is about 300 miles southwest of Chapada, and about the same distance west of the type locality of *urucumus*.

Genus **Simosciurus** gen. nov.

Text Fig. 12 (p. 164); Plate XII, Figs. 1–3; Plate XIV, Figs. 5, 6.

Type, *Sciurus stramineus* Eydoux and Souleyet.

Size large; tail long and narrow, the vertebræ about 52 % of the total length; mammæ, 8; pelage very long and thick.

Premolars, $\frac{1}{1}$. Skull short, due mainly to the extremely short rostrum; nasals very broad and short, about 22 % of the total length of the skull, and only about 60 % of the interorbital breadth instead of 90 % as in *Urosciurus;* dorsal profile flattened and nearly straight over the mid-dorsal half of the skull as in *Urosciurus,* not highly convex as in the small and medium-sized South American squirrels; zygomata slightly convergent anteriorly; malar broad and heavy, without superior expansion; dentition of rather more than medium strength, similar in structural details to that of the other large South American squirrels.

Geographic distribution.— Southwestern Ecuador and northwestern Peru. (See map, p. 300.)

Remarks.— The distinctive features of *Simosciurus* are the extremely short rostrum, giving the skull a peculiar snub-nosed effect, the correlatively very short and broad nasals, and the heavily developed zygomata. While the tail is long, the numerous specimens at hand show it to be narrow and lightly haired in comparison with *Hadrosciurus* and *Urosciurus.* The genus is thus far represented by only *Sciurus stramineus* and its several subspecies, geographically restricted to a comparatively limited area in southwestern Ecuador and northwestern Peru bordering the Gulf of Guayaquil.

Species and Subspecies of Simosciurus, with type localities and statement of number of specimens examined.

Simosciurus stramineus stramineus (Eydoux and Souleyet). Omatope, Peru. Specimens examined, 8.

Simosciurus stramineus nebouxii (I. Geoffroy). Near Payta, Peru. Specimens examined, 5.

Simosciurus stramineus guayanus (Thomas). Balzar Mountains, western Ecuador. Specimens examined, 0.

Simosciurus stramineus zarumæ (Allen). Zaruma, southwestern Ecuador. Specimens examined, 1.

Key to the Subspecies of Simosciurus.

With a nuchal white patch.

Upperparts yellowish gray, underparts whitish gray......*nebouxii* (p. 282)
Upperparts deep yellowish rufous, underparts brownish gray..*zarumæ* (p. 284)

With no nuchal white patch.

Upperparts dark, washed with yellowish gray; underparts dark brown. *stramineus* (p. 281)

Upperparts pale, underparts dark brown washed mesially with gray. *guayanus* (p. 283)

Simosciurus stramineus stramineus (*Eydoux and Souleyet*).

Text Fig. 12 (p. 164); Plate XII, Figs. 1–3; Plate XIV, Figs. 5, 6.

Sciurus stramineus EYDOUX and SOULEYET, Voy. Bonite, Zool., I, 1841, p. 73, pl. ix.— TSCHUDI, Fauna Peruana, Therologie, 1844, p. 159.— ALSTON, Proc. Zool. Soc. London, 1878, p. 664 (part).— ALLEN, Bull. U. S. Geol. and Geogr. Surv. Territories (Hayden), IV, No. 4, p. 883, Dec. 11, 1878.— THOMAS, Ann. and Mag. Nat. Hist. (7), V, pp. 150, 151, Jan. 1900 (in text).

Sciurus hypopyrrhus ALLEN (not of Wagler), Mon. N. Amer. Rodentia, 1877, p. 746 (part, only the Guayaquil specimens).

Macroxus fraseri GRAY, Ann. and Mag. Nat. Hist. (3), XX, p. 430, Dec. 1867. Ecuador. (*Cf.* Thomas, *l. c.*, p. 150).

Type locality.— Omatope, Peru.

Geographic distribution.— Western slope of the Andean region of northwestern Peru and southwestern Ecuador.

Description.— Pelage full, rather coarse, with abundant underfur; tail narrow and long. Mammæ 8 (variable in different specimens, the full number not always being functionally developed). Very variable in coloration through purely individual differentiation.

Upperparts (an average specimen from Guayaquil), hairs deep black for the basal seven eighths, narrowly tipped with pale yellowish gray on the nape, shoulders, front half of the dorsal region and sides of body; lower back, rump, and basal sixth of tail with the hairs broadly tipped with dark rufous; top of head and nose black, the hairs minutely punctated with rufous; sides of head dull hazel with a blackish wash; underparts dark rusty brown, with whitish hair tips over the median area; fore limbs externally with the hair tips pale rufous, deepening to clear rufous at the carpus and base of metacarpals, passing into black on the toes; fore limbs internally like the ventral surface, passing into dark rufous at the carpal joint; hind limbs externally like the lower back and base of tail, the feet black slightly varied with dark rufous proximally; tail at extreme base (both above and below) mixed dark chestnut and black; rest of the tail black washed with white, the hairs black with white or pale yellowish white tips.

Two other Guayaquil specimens differ from the above in having the posterior half of the dorsal area, hind limbs, and base of tail chestnut rufous, and the underparts much darker — brownish black with the hair tips rufous instead of whitish, and the feet deep black. In still another specimen the rump, hind limbs, and base of tail are pale yellowish rufous, the underparts rusty brown with the hair tips lighter, and the fore and hind feet pale rufous with only the toes black, those of the hind feet mixed rufous and black. Three of the above mentioned four specimens are profusely spotted on the fore-back, shoulders, limbs, throat and breast, with irregularly distributed tufts of projecting stiff white hairs, due probably to injuries caused by bites of insects. They are more or less commonly seen in all the squirrels, both large and small, occurring in the humid tropical coast belt from Peru northward to Central America.

Another series of 4 specimens from Daule, situated about 50 miles northwest of Guayaquil, parallels the 4 specimens from Guayaquil in respect to individual color variation. In one the ventral surface is quite heavily washed with rufous; in another the feet are rufous to the base of the toes, and in others the rufous of the tarsal and carpal regions extends on to the proximal portion of the foot.

The only external measurements available are the collector's measurements of the Daule specimens, 3 adult females: total length, 585 (570–620 mm.); head and body, 283 (260–320); tail vertebræ, 303 (300–310); hind foot, 60 (all 60). An adult male from Guayaquil, total length, 630; head and body, 300; tail vertebræ, 330; hind foot, 65.

Five skulls (Guayaquil, 1, Daule, 4; 2 ♂♂, 3 ♀♀), total length, 58 (57–60); zygomatic breadth, 32.2 (32–33); interorbital breadth, 19 (18–20); postorbital breadth, 17.5 (17–18); breadth of braincase, 22.7 (22–23.5); nasals, 16 × 8.6 (15–17 × 8–9); diastema, 14.2 (14–14.5); maxillary toothrow, 10.3 (10–10.5). The skull is small relatively to the external measurements, with heavy dentition, and short, broad nasals, their breadth at the front border about one half of the length.

Specimens examined, 8.— **Ecuador**: Guayaquil, 4 (Am. Mus. 1, Nat. Mus. 2, Mus. Comp. Zoöl. 1); Daule, 4 (Am. Mus.).

Remarks.— This was the first described form of the large, long-tailed squirrels peculiar to the western slope of the Andean region of Ecuador and Peru, of which several others have since been recognized.

Simosciurus stramineus nebouxii (*Is. Geoffroy*).

Sciurus nebouxii Is. Geoffroy, Voy. de la Venus, Zool., 1855, p. 165, pl. xii.— Allen, Mon. N. Amer. Rodent., 1877, p. 773.

Sciurus stramineus Alston, Proc. Zool. Soc. London, 1878, p. 664, part.— Allen, Bull. U. S. Geol. and Geogr. Surv. Territories (Hayden), IV, No. 4, p. 883, part.

Sciurus stramineus nebouxii Thomas, Ann. and Mag. Nat. Hist. (7), V, p. 151, Jan. 1900 (in text).

Type locality.— Near Payta, Peru.

Geographic distribution.— Northwestern corner of Peru. Recorded from Sapotillo (Thomas, *l. c.*), Tumbez, and Payta.

Description.— Similar to *Simosciurus stramineus stramineus*, but coloration much lighter throughout and with a white nape patch. Upperparts yellowish gray, passing into pale fulvous on the lower back and extreme base of the tail; a large patch (about 30 mm. square) of yellowish white or clear white on the nape, the hairs white to the base; underparts whitish gray, passing into white on the throat and (in some specimens) on the inside of the fore limbs; fore limbs externally like the back, internally like the ventral surface; upper surface of fore feet intense black, with no fulvous wash at the wrists; hind limbs externally washed with fulvous like the lower back, increasing in intensity at the ankles; upper surface of feet intense black; tail above at extreme base more or less suffused with fulvous; rest of the tail (both surfaces) black heavily washed with white, usually faintly tinged with fulvous.

The above is a description of the coloration in a series of four specimens; another specimen varies from this standard in having the lower back more strongly washed with fulvous, which increases in intensity on the outer surface of the hind limbs.

Two specimens (adult females) from Marsopon, collected and measured by P. O. Simons: total length, 530, 540 mm.; head and body, 250, 265; tail vertebræ, 280, 275; hind foot, s. u., 60, 62; ear, 36. 39.

Two skulls from Tumbez: total length, 58.2, 55.5; zygomatic breadth, 33, 32; interorbital breadth, 19, 19; postorbital breadth, 17, 17; breadth of braincase, 22, 22.5; nasals, 18 × 9, 16 × 8; diastema, 14, 13.2; maxillary toothrow, 10, 10.

Specimens examined, 5.— **Peru**: Marsopon, 2 (Br. Mus.); Tumbez, 3 (Mus. Comp. Zoöl.).

Remarks.— Differs from true *stramineus* in lighter coloration through the greater length of the light hair tips, both above and below, the absence of fulvous or rufous at the wrists, the much paler tint of the suffusion of the hind limbs and lower back, and the presence of a large squarish white patch on the nape.

Simosciurus stramineus guayanus (*Thomas*).

Sciurus stramineus guayanus Thomas, Ann. and Mag. Nat. Hist. (7), V, p. 150, Jan. 1900.

Type locality.— Balzar Mountains, Upper Palenque River, western Ecuador.

Geographic distribution.— Known only from the type locality, "west of Guayaquil," Ecuador.

Description.— Similar to *S. stramineus stramineus* but general coloration lighter, nearly as in *S. s. nebouxii,* from which it differs in having no nuchal patch of white.

Total length (from skin), 580 mm.; "head and body, 270; tail, 310; hind foot (wet), 57; ear (wet), 26." — Thomas, *l. c.*

Specimens examined, 0.— **Ecuador**: No specimens are at present available for study, but the type and topotype were casually examined at the British Museum in April, 1913.

Remarks.— In coloration, except in the absence of the white nuchal patch and the rufous wrists and ankles, *guayanus* closely resembles *nebouxii,* being much lighter colored throughout than true *stramineus.* It differs from *zarumæ* in the absence of a white nape patch and in gray instead of rufous upperparts.

Simosciurus stramineus zarumæ (*Allen*).

Sciurus stramineus zarumæ Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 597, Sept. 8, 1914.

Type locality.— Zaruma, southwestern Ecuador; altitude 6000 feet.

Geographic distribution.— Known only from the type locality.

Description.— "Like *S. stramineus nebouxi* in the presence of a large white nape patch, but widely different in general coloration from either typical *stramineus* or *nebouxi.*

"Upperparts (except the white nape patch) washed with yellowish rufous, more heavily and more intensely (approaching tawny) on the posterior half of the back and hind limbs, more lightly on the head and anterior half of back, the black basal portion of the pelage wholly concealed by the long rufous tipping of the hairs, which on the lower back occupies the apical half; nose and outside of fore limbs grayish; underparts gray, passing into white on the throat, upper breast, inside of fore limbs and inguinal region; upper surface of fore and hind feet intense black, wrists rufous, especially the inner surface, and the rufous on the hind limbs extends slightly beyond ankles; tail rufous all around where it joins the body, the rest black heavily washed with white.

"Total length (collector's measurements), 540 mm.; head and body, 220; tail vertebræ, 320; hind foot, 60. Skull, total length —; zygomatic breadth, —; interorbital breadth, 19; postorbital breadth, 17; breadth of braincase, 23; nasals, —; diastema, 14; maxillary toothrow, 10. The nasals and zygomatic arches are unfortunately broken.

Remarks.— "Although represented by only a single specimen, the color differences are so profound that, taken with the geographical conditions, it is hard to believe that they do not denote a strongly marked form of the *stramineus* group. The rufous tips of the hairs on the lower back are as long as the dark basal portion." — Allen, *l. c.*

Table VIII.—Measurements of species and subspecies of Hadrosciurus, Simosciurus and Urosciurus.

Species, localities, and by whom collected and measured		External measurements: Number of specimens	Total length	Head and body	Tail vertebræ	Hind foot	Cranial measurements: Number of specimens	Total length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of nasals	Maxillary toothrow	Diastema
H. flammifer	Aver.	10	580	274	310	66.5^{c}	5	65.5	38	23	26.5	20	10.5	
Caura district, Venezuela	Min.		540	254	280	64		64	37	22	26	19	10	
Klages and Carriker	Max.		610	289	320	67		67	39	25	27	21	11	
U. tricolor		1	533	273	260	69^{c}	2	69	38.7	21	24	22	10	21
								70.3	39.3	21	24	20	10	
U. duida	Aver.	3	570	270	300	66^{c}	Type	66	38	20	25	22	10	19
Mt. Duida, Ven.	Min.		560	270	290	65								
Leo E. Miller	Max.		580	270	310	67								
U. igniventris	Aver.	3	530	270	260	65^{c}	1	63	37	23	26.3	19	9.8	
Peru	Min.		520	260	250	63^{c}								
W. H. Osgood	Max.		540	280	270	67								
U. i. tædifer		1	505	259	246	67^{c}	1	63	37	22	27	19	10	
U. i. cocalis		2	569	266	295	68^{c}	2	63	38	22.2	25	20	10	
			559	276	283	64		62	37	—	25	19	10	
U. i. zamoræ		1	490	260	230	61^{c}	1	59	33.5	19	25	16.3	9.2	
U. langsdorffii	Aver.						8	62	36.4	20.4	23.8	18	9.8	18
Chapada, Brazil	Min.							60.8	35	20	23.3	17.3	9.3	17.5
H. H. Smith	Max.							64	38	21	24.3	19	10	19
U. l. steinbachi	Aver.	5	491	254	235	55^{s}	5	60.6	36	20.6	23.6	18.3	9	
Southwest Bolivia	Min.		475	250	225	55		60.2	35	20	23	17.8	9	
J. Steinbach	Max.		505	260	255	55		61	37	21	24	19.8	9.2	
U. l. urucumus	Aver.	6	502	251	250	60.5^{s}	7	59	35	19.6	18.3	18.3	8.8	17
Matto Grosso, Brazil	Min.		490	240	230	60		57	34.6	19	18	17.5	8.3	16
Leo E. Miller	Max.		530	260	260	63		61	36	21	19	19	9.2	18
S. stramineus	Aver.	3	586	283	303	60^{s}	5	58	32.2	19	22.7	16	10.3	14.2
	Min.		570	260	300	60		57	32	18	22	15	10	14
	Max.		620	320	310	60		60	33	20	23.5	17	10.5	14.5
S. s. nebouxii	Aver.	2	535	258	278	61^{s}	2	56.7	32.5	19	22.3	17	10	13.6
	Min.		530	250	275	60		55.2	32	19	22	16	10	13.2
	Max.		540	265	280	62		58.2	33	19	22.5	18	10	14
S. s. guayamus		Type	580	270	310	57^{s}								
S. s. zarumæ		Type	540	220	320	60^{c}		—	—	19	23	—	10	14

EXPLANATION OF PLATES VII–XIV.

Plate VII.

All figures nat. size.

Figs. 1–3. *Nannosciurus whiteheadi* Thomas. No. 32628, Am. Mus., ♀ ad., Sarawak, Borneo.

Figs. 4–6. *Microsciurus similis similis* (Nelson). No. 32499, Am. Mus., ♀ ad., Cocal, Western Andes, Colombia.

Figs. 7, 8. *Leptosciurus pucheranii pucheranii* (Fitzinger). No. 34681, Am. Mus., ♂ ad., near Bogotá, Colombia.

Figs. 10–12. *Leptosciurus ignitus irroratus* (Gray). No. 16560, Am. Mus., ♀ ad., Inca Mines, Peru.

Figs. 13–14. *Leptosciurus leucogaster* (Gray). Collector's No. 448, Carnegie Mus., Pittsburgh, ♀ ad., Prov. del Sara, Bolivia.

Plate VIII.

All figures nat. size.

Figs. 1–3. *Mesosciurus hoffmanni hoffmanni* (Peters). No. 18089, Amer. Mus., ♂ ad., Mt. Irazú, Costa Rica.

Figs. 4, 5. *Mesosciurus gerrardi gerrardi* (Gray). No. 34130, Am. Mus., ♀ ad., Bagado, Colombia.

Figs. 7, 8. *Mesosciurus saltuensis bondæ* (Allen). No. 15230, Am. Mus., ♀ ad., Minca, Santa Marta, Colombia.

Figs. 9, 10. *Mesosciurus gerrardi milleri* (Allen). No. 32512, Am. Mus., ♀ ad., Cocal, Western Andes, Colombia.

Plate IX.

All figures nat. size.

Figs. 1–3. *Notosciurus rhoadsi* Allen. *Type.* No. 12725, Mus. Acad. Nat. Sci. Philadelphia, ♂ juv., Pagama Forest, Chunchi, Ecuador.

Figs. 4–6. *Guerlinguetus æstuans æstuans* (Linné). No. 36492, Am. Mus., ♂ ad. Bonasica, Essequibo River, British Guiana.

Fig. 8. *Guerlinguetus æstuans gilvigularis* (Wagner). No. 12297, Mus. Comp. Zoöl., ♂ ad., Obidos, Brazil.

Figs. 9, 10. *Guerlinguetus ingrami* (Thomas). No. 36488, Am. Mus., ♂ ad., Alambary, São Paulo, Brazil.

Plate X.

All figures nat. size.

Figs. 1–3. *Urosciurus tricolor* (Pœppig). No. 19672, Field Mus., Chicago, ♀ ad., Yurimaguas, Peru.

Figs. 4–6. *Urosciurus duida* (Allen). *Type.* No. 36153, Am. Mus., ♀ ad., Rio Cunucunumá, base of Mt. Duida, Venezuela.

Plate XI.

Figs. 1–3. *Urosciurus pyrrhonotus pyrrhonotus* (Wagner). No. 37076, Am. Mus., ♂ ad., Calama, lower Rio Madeira, Brazil.

Figs. 4–6. *Urosciurus langsdorffii langsdorffii* (Brandt). No. 4837, Mus. Acad. Nat. Sci. Philadelphia, ♂ ad., Chapada, Matto Grosso, Brazil.

Plate XII.

Figs. 1–3. *Simosciurus stramineus stramineus* (Eydoux and Souleyet). No. 34687, Am. Mus., ♂ ad., Daule, Ecuador.

Figs. 4–6. *Hadrosciurus flammifer* (Thomas). No. 17562, Am. Mus., ♂ ad., La Union, Venezuela.

Plate XIII.

All figures $\frac{3}{1}$.

Fig. 1. *Nannosciurus whiteheadi* Thomas. No. 34687, Am. Mus., ♂ ad., Sarawak, Borneo. Direct crown view of maxillary toothrows.

Fig. 2. Same specimen as Fig. 1. Oblique view of left maxillary toothrow.

Fig. 3. *Microsciurus similis similis* (Nelson). No. 32499, Am. Mus., ♀ ad., Cocal, Western Andes, Colombia. Direct crown view of maxillary toothrows.

Fig. 4. Same specimen as Fig. 3. Oblique view of left maxillary toothrow.

Fig. 5. *Leptosciurus pucheranii pucherannii* (Fitzinger). No. 32839, Am. Mus., ♂ ad., near Bogotá, Colombia. Direct crown view of maxillary toothrows.

Fig. 6. Same specimen as Fig. 5. Oblique view of left maxillary toothrow.

Fig. 7. *Leptosciurus ignitus ignitus* (Gray). No. 1253, Am. Mus., Yungas, Bolivia. Direct crown view of left maxillary toothrow.

Fig. 8. Same specimen as Fig. 7. Oblique view of left upper maxillary toothrow.

Fig. 9. *Leptosciurus leucogaster* (Gray). Collector's No. 448, Carnegie Mus., Pittsburgh, ♀ ad., Prov. del Sera, Bolivia. Direct crown view of left maxillary toothrow.

Fig. 10. Same specimen as Fig. 9. Oblique view of left maxillary toothrow.

Fig. 11. *Mesosciurus hoffmanni hoffmanni* (Peters). No. 18094, Am. Mus., ♂ ad., Mt. Irazú, Costa Rica. Direct crown view of maxillary toothrows.

Fig. 12. Same specimen as Fig. 11. Oblique view of left maxillary toothrow.

Fig. 13. *Mesosciurus gerrardi gerrardi* (Gray). No. 34130, Am. Mus., ♀ ad., Bogotá, Colombia. Direct crown view of left maxillary toothrow.

Fig. 14. Same specimen as Fig. 13. Oblique view of left maxillary toothrow.

Fig. 15. *Mesosciurus saltuensis bondœ* (Allen). No. 11184, Am. Mus., ♀ ad., Minca, Santa Marta, Colombia. Direct crown view of left maxillary toothrow.

Fig. 16. Same specimen as Fig. 15. Oblique view of left maxillary toothrow.

Fig. 17. *Mesosciurus gerrardi milleri* (Allen). No. 32512, Am. Mus., ♀ ad., Cocal, Western Andes, Colombia. Direct crown view of left maxillary toothrow.

Fig. 18. Same specimen as Fig. 15. Oblique view of left maxillary toothrow.

Fig. 19. *Guerlinguetus œstuans œstuans* (Linné). No. 34657, Am. Mus., ♂ ad., Potario Landing, British Guiana. Direct crown view of maxillary toothrow.

Fig. 20. Same specimen as Fig. 19. Oblique view of left maxillary toothrow.

Fig. 21. *Guerlinguetus œstuans gilvigularis* (Wagner). No. 12297, Mus. Comp. Zoöl., ♂ ad., Obidos, Brazil. Direct crown view of left maxillary toothrow.

Fig. 22. Same specimen as Fig. 21. Oblique view of left maxillary toothrow.

Fig. 23. *Guerlinguetus ingrami* (Thomas). No. 36487, Am. Mus., ♂ ad., Alambary, São Paulo, Brazil. Direct crown view of left maxillary toothrow.

Fig. 24. Same specimen as Fig. 23. Oblique view of left maxillary toothrow.

Plate XIV.

Fig. 1. *Urosciurus duida* (Allen). No. 36153, Am. Mus., ♀ ad., near Mt. Duida, Venezuela. Direct crown view of maxillary toothrows.

Fig. 2. Same specimen as Fig. 1. Oblique view of left maxillary toothrow.

Fig. 3. *Urosciurus igniventris igniventris* (Wagner). No. 34375, Am. Mus., Florencia, Caquetá, Colombia. Direct crown view of left maxillary toothrow.

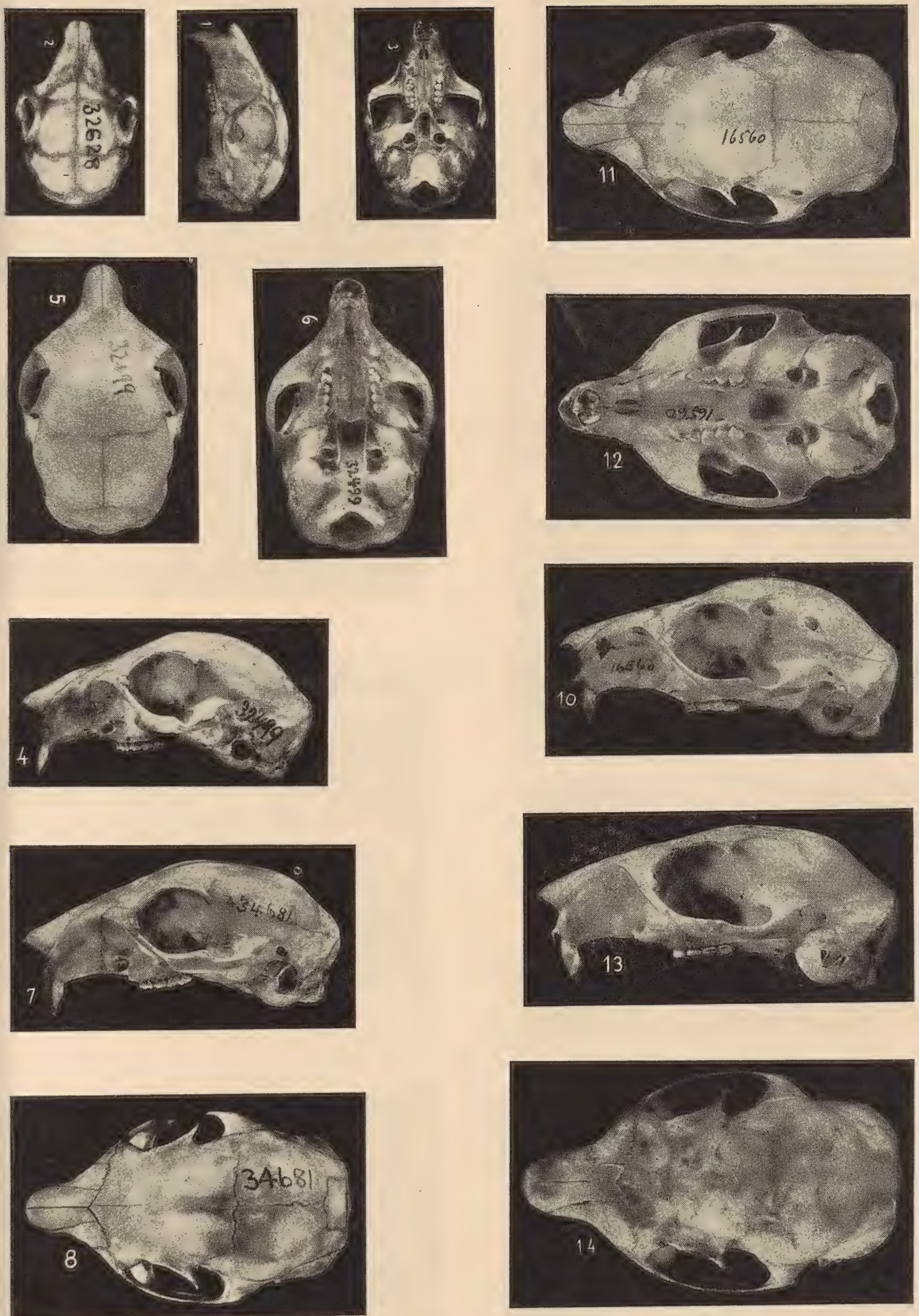
Fig. 4. Same specimen as Fig. 3. Oblique view of left maxillary toothrow.

Fig. 5. *Simosciurus stramineus stramineus* (Eydoux and Souleyet). No. 34687, Am. Mus., ♀ ad., Daule, Ecuador. Oblique view of left maxillary toothrow.

Fig. 6. Same specimen as Fig. 5. Direct crown view of maxillary toothrows.

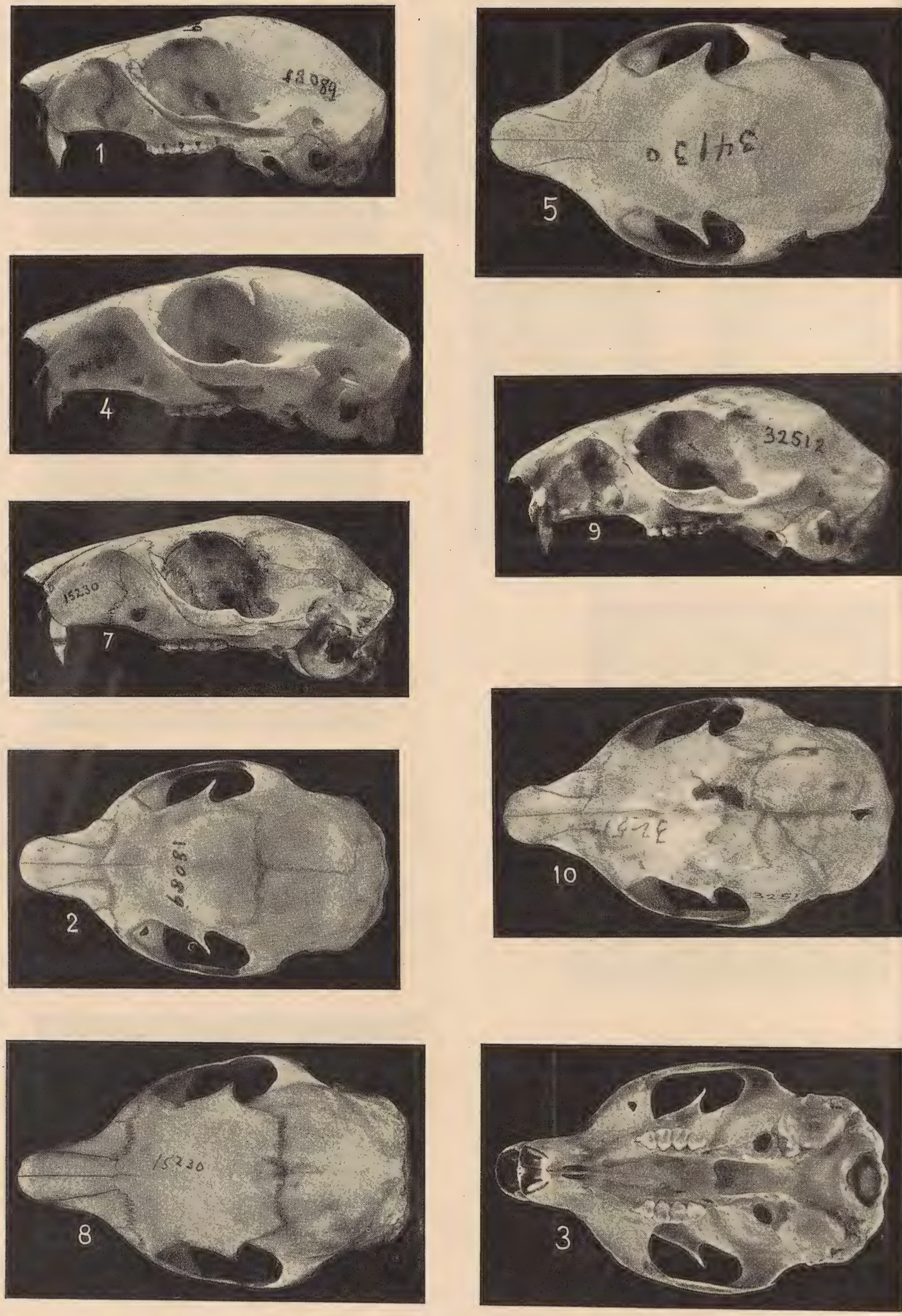
Fig. 7. *Hadrosciurus flammifer* (Thomas). No. 16944, Am. Mus., ♂ ad., La Union, Venezuela. Oblique view of left maxillary toothrow.

Fig. 8. Same specimen as Fig. 7. Direct crown view of left maxillary tooth row.



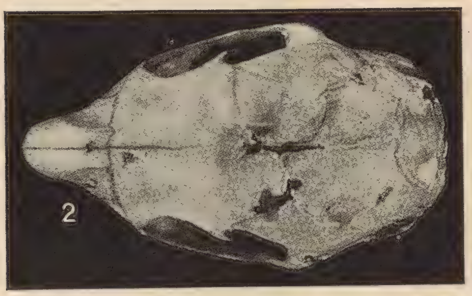
All figures nat. size.

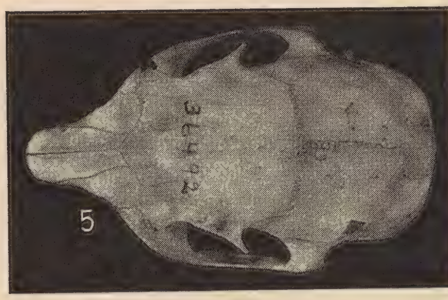
Figs. 1–3. Nannosciurus whiteheadi.
" 4–6. Microsciurus similis similis.
Figs. 7, 8. Leptosciurus pucheranii pucheranii.
" 10–12. " ignitus irroratus.
Figs. 13, 14. Leptosciurus leucogaster.

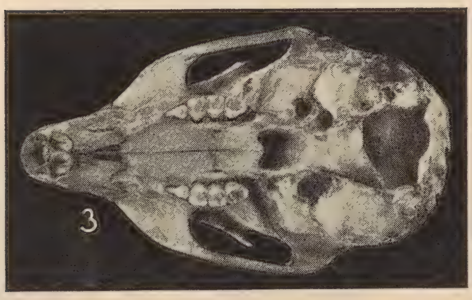


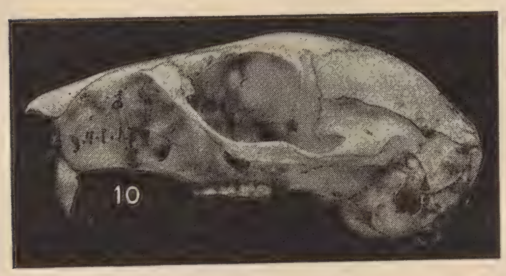
All figures nat. size.

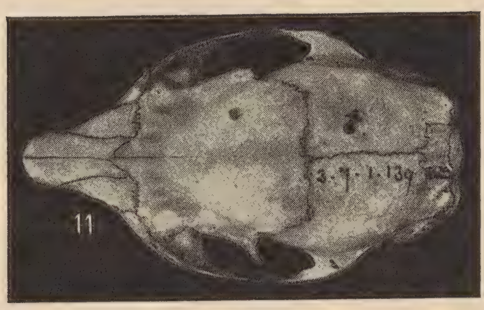
Figs. 1–3. Mesosciurus hoffmanni hoffmanni.
" 4, 5. " gerrardi gerrardi.
Figs. 7, 8. Mesosciurus satuensis bondæ.
" 9, 10. " gerrardi milleri.

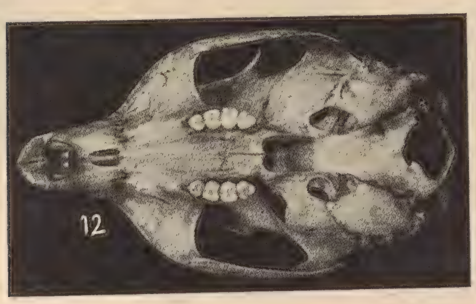






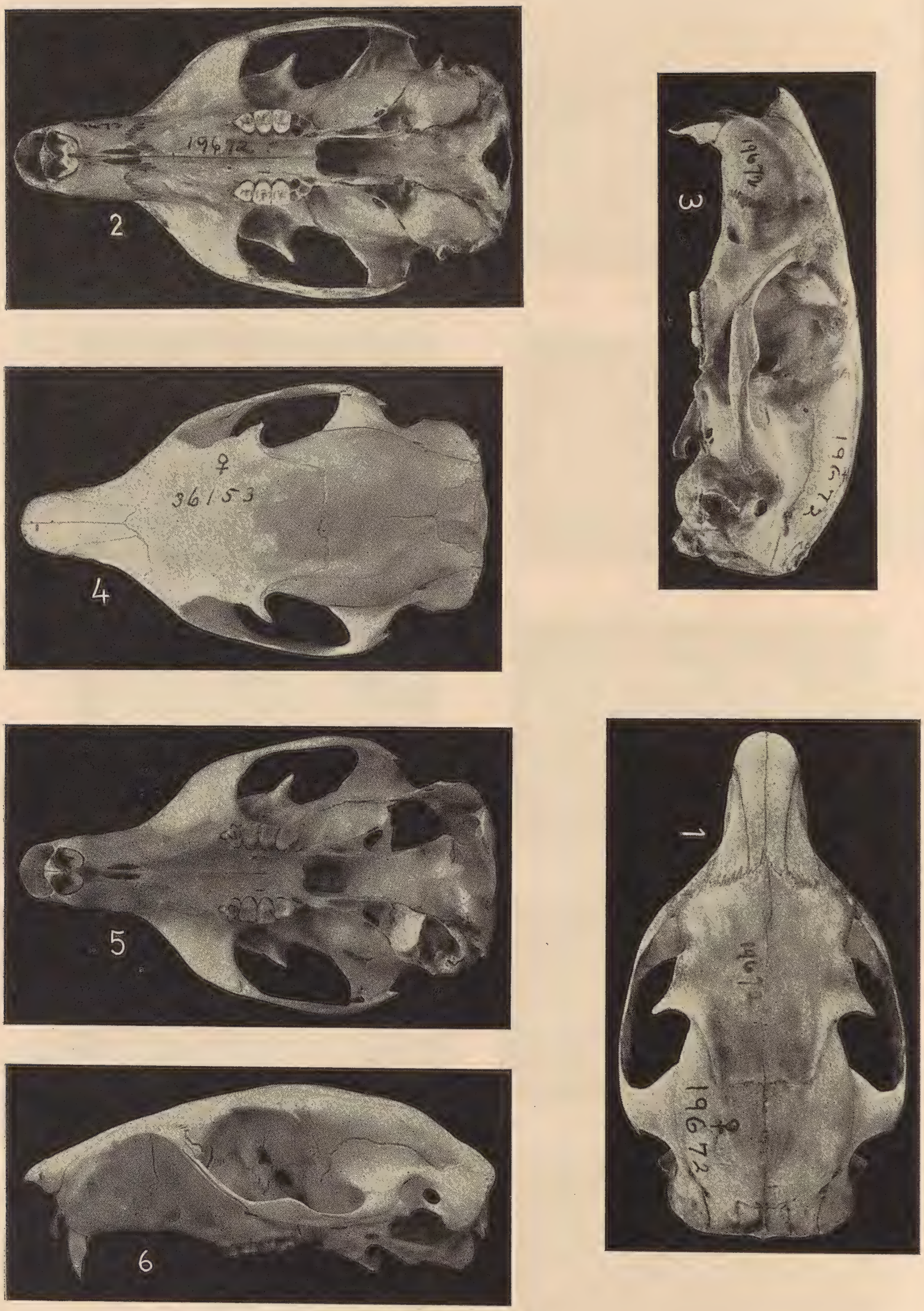






All figures nat. size.

Figs. 1–3. Notosciurus rhoadsi.
" 4–6. Guerlinguetus æstuans æstuans.
" 8. " æstuans gilvigularis.
" 9, 10. " ingrami.



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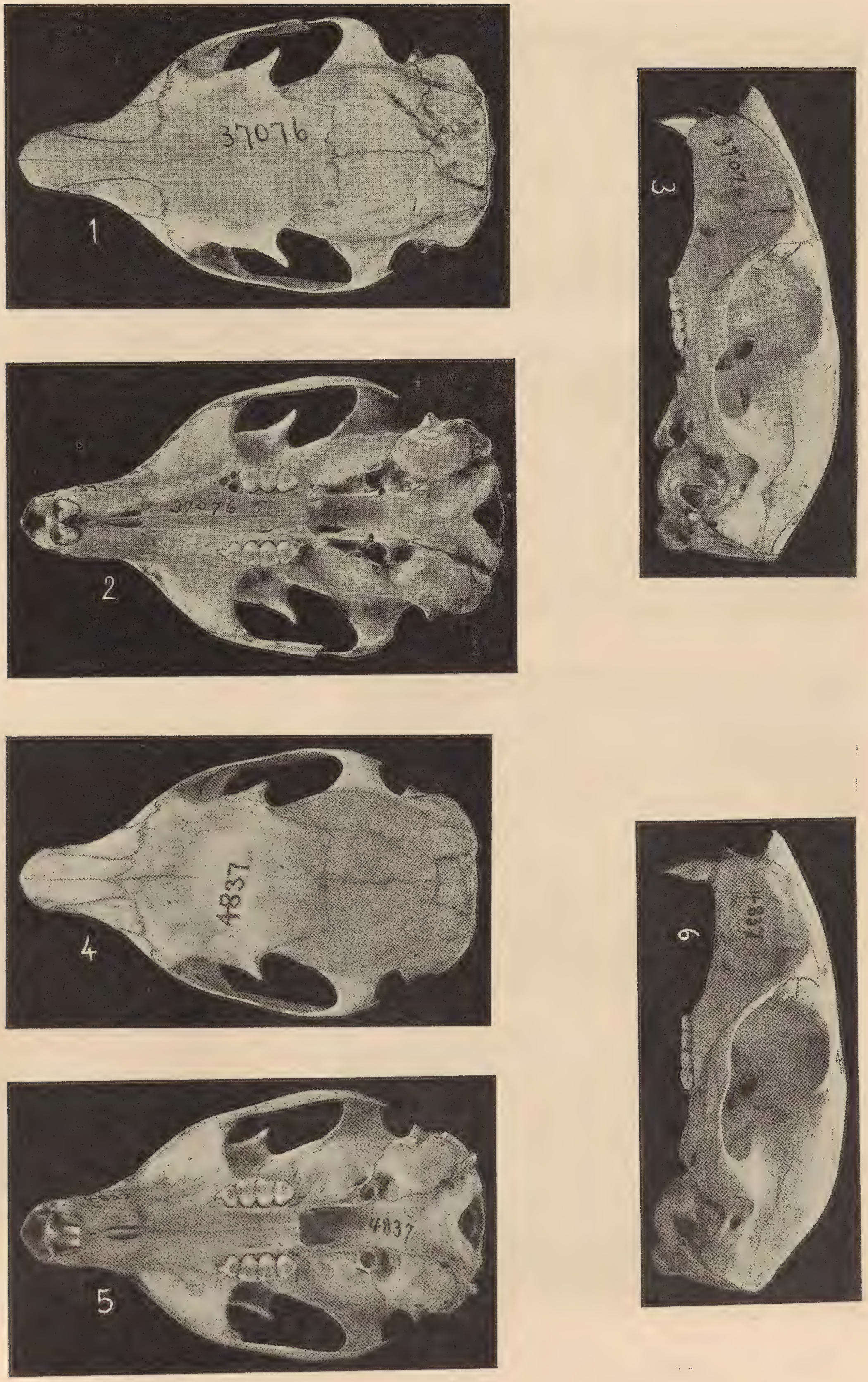
Figs. 1–3. Urosciurus tricolor. Figs. 4–6. Urosciurus duida.



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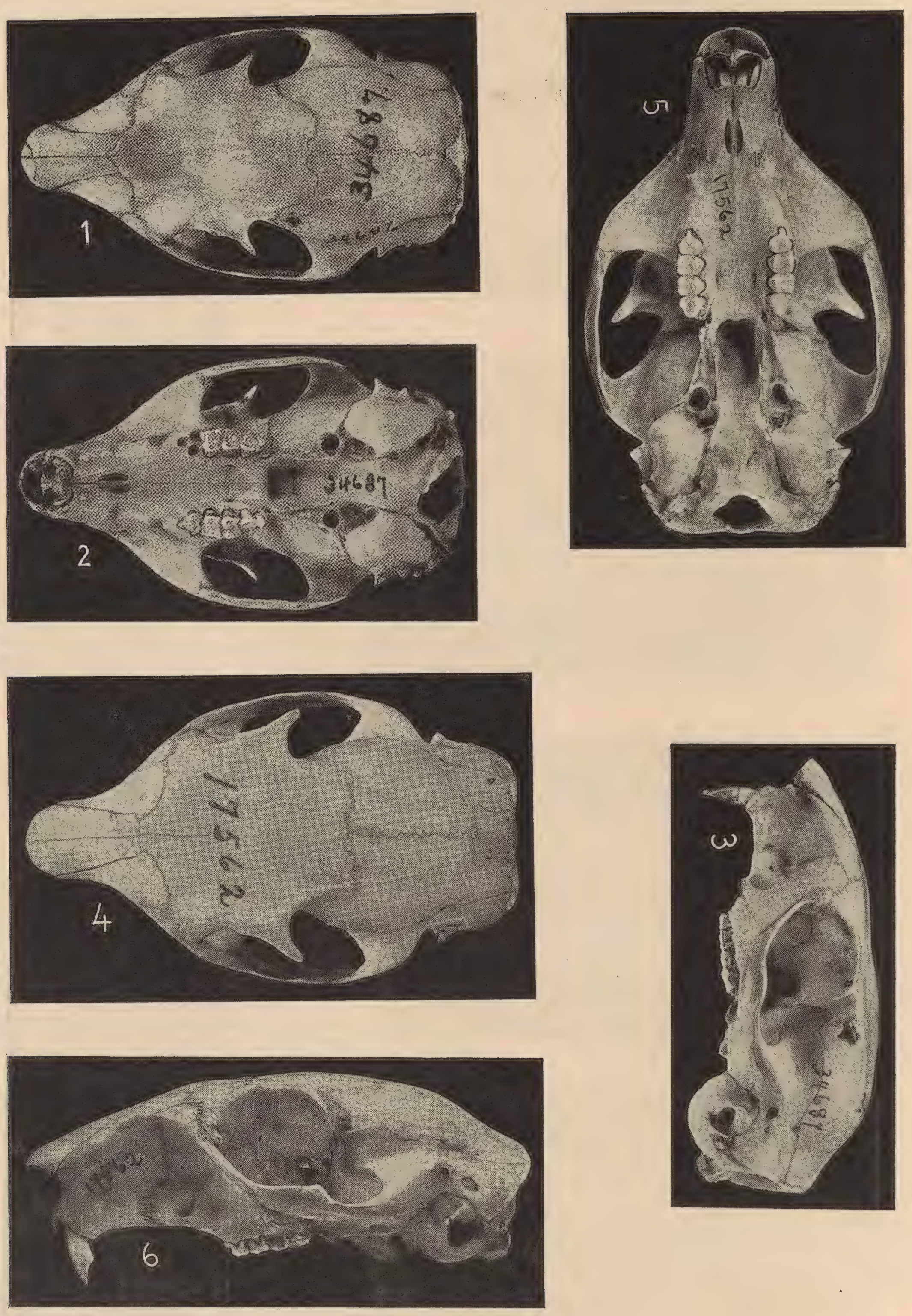
Figs. 1–3. Urosciurus pyrrhonotus pyrrhonotus.
" 4–6. " langsdorffi langsdorffi.



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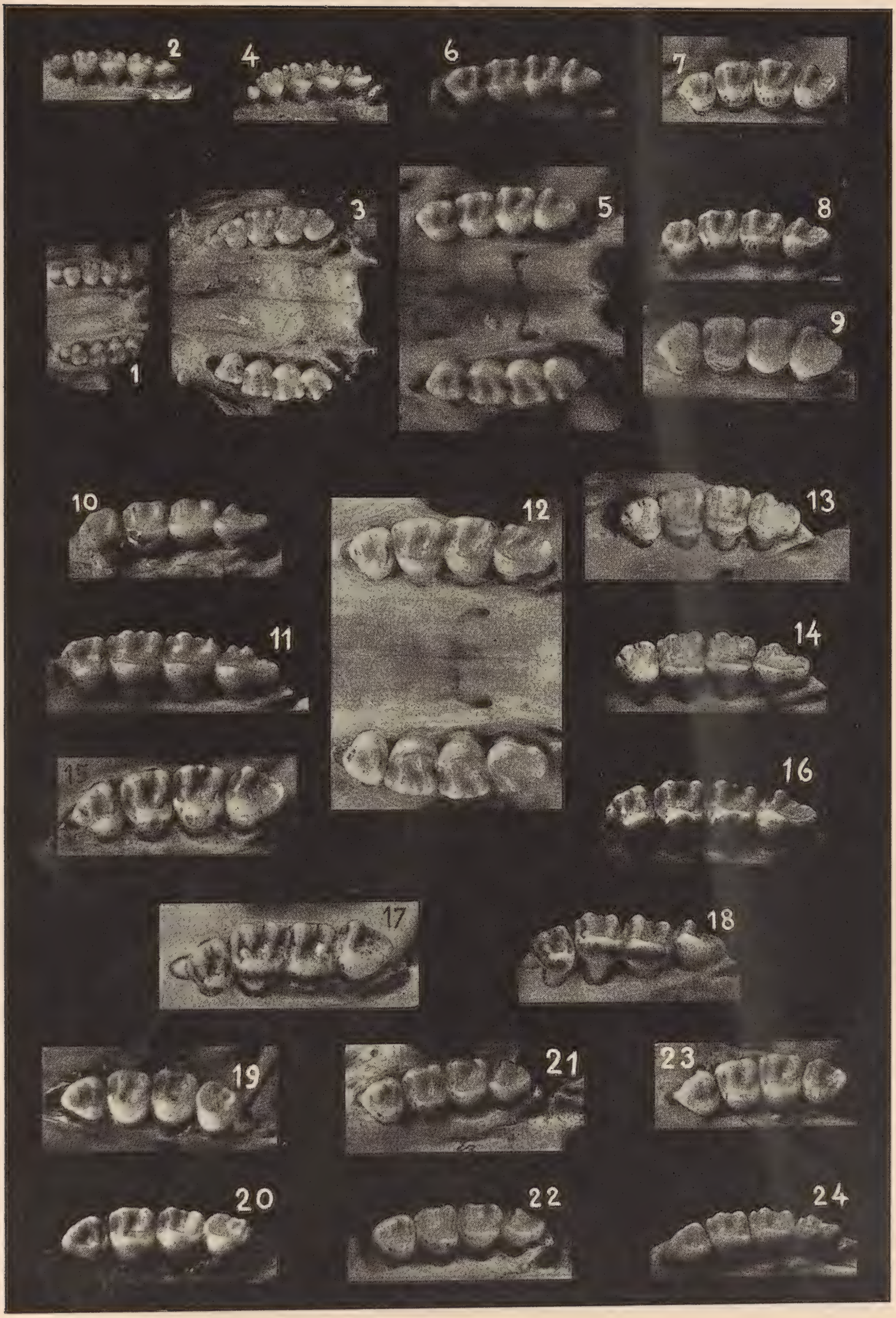
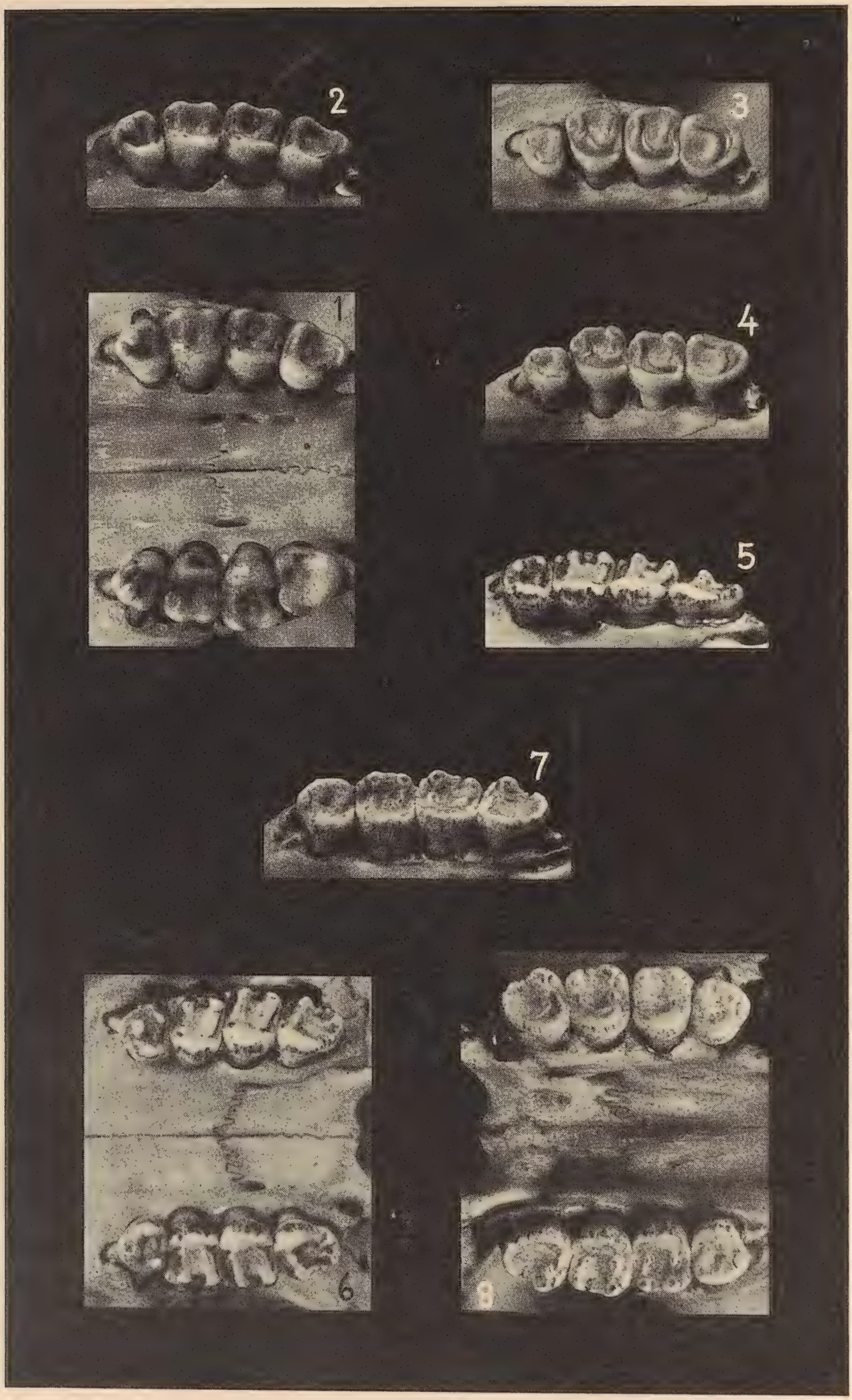
Figs. 1–3. Simosciurus stramineus stramineus. Figs. 4–6. Simosciurus flammifer.



All figures $\frac{3}{1}$.

Figs. 1, 2.	Nannosciurus whiteheadi.	
" 3, 4.	Microsciurus similis similis.	
" 5, 6.	Leptosciurus p. pucheranii.	
" 7, 8.	"	ignitus irroratus.
" 9, 10.	"	leucogaster.
" 11, 12.	Mesosciurus hoff. hoffmanni.	
Figs. 13, 14.	Mesosciurus ger. gerrardi.	
" 15, 16.	"	saltuensis bondæ.
" 17, 18.	"	gerrardi milleri.
" 19, 20.	Guerlinguetus æst. æstuans.	
" 21, 22.	"	" gilvigularis.
" 23, 24.	"	ingrami.



All figures $\frac{3}{1}$.

Figs. 1, 2. Urosciurus duida.
" 3, 4. " igniventris igniventris.
" 5, 6. Simosciurus stramineus stramineus.
" 7, 8. Hadrosciurus flammifer.

Geographic Distribution and Interrelationships of South American Squirrels.

As shown in the foregoing pages, the squirrel fauna of South America, embracing some 75 species and subspecies, is separable into 9 natural and well circumscribed superspecific groups, here allotted the value of genera; some of them include two or more well marked sections. The geographic distribution of these groups is correlated with areas markedly different in physiographic features. While such correlation is to be expected, it seems worth while to point out in some detail the nature and extent of these agreements.

The striking topographic features of South America are the highlands of the coast borders and the vast extent of the interior lowlands, creating conditions of environment that result in strong biologic reactions, as most of the land area is intertropical. The geologically oldest parts of the continent are well known to be the Guianian and Brazilian highlands of the Atlantic border, the Andean ranges of the Pacific border having come into existence much later, and the interior of the continent remaining an inland sea till long after the Caribbean, Pacific, and Atlantic borders had become dry land. The present topographic conditions, however, have long prevailed, and it is these only that we have here especially to consider.

So far as climatic conditions are concerned, the whole continent of South America should be the home of some species of squirrel, the southern extremity of the continent being well within the climatic range of squirrels in other lands. But in South America they are of by no means universal distribution, as forests are necessary for the existence of tree squirrels, the only members of the family Sciuridæ which have found their way to any part of tropical or even subtropical America. Vast areas of South America are forestless. More than half of Venezuela consists of treeless plains or llanos; large portions of Brazil are open grassy or scrubby campos, while much the greater part of the southern third of the continent consists of pampas, nearly treeless steppes, or open chaco country. These immense open spaces are nearly as effective barriers to tree squirrels as would be great inland seas. They afford them not only no congenial living conditions but interpose barriers to their dispersion.

In general terms, squirrels are restricted in South America to a narrow belt near the Caribbean coast, from the Island of Trinidad (geographically and faunally a detached fragment of the continent) and the Paria Peninsula west to where the Sierra de Mar merges into the Sierra de Merida, and thence over the great Andean system of the western border of the continent.

Throughout this system squirrels are found in considerable variety as far south as about to the northern border of Chile, beyond which they appear to have failed to penetrate, their most southern point in the western half of the continent being southern Bolivia.

On the eastern side of the continent, south of the Venezuelan llanos, they occupy the Guiana Highlands and the forested parts of the Brazilian Highlands south to southern Brazil, and extend thence westward in the wooded parts of the drainage areas of the Orinoco and Amazon to the eastern base of the Andes. But these several widely different physiographic areas are each occupied by special types of squirrel, none of the groups recognized as generic being common to any portion of both the eastern and

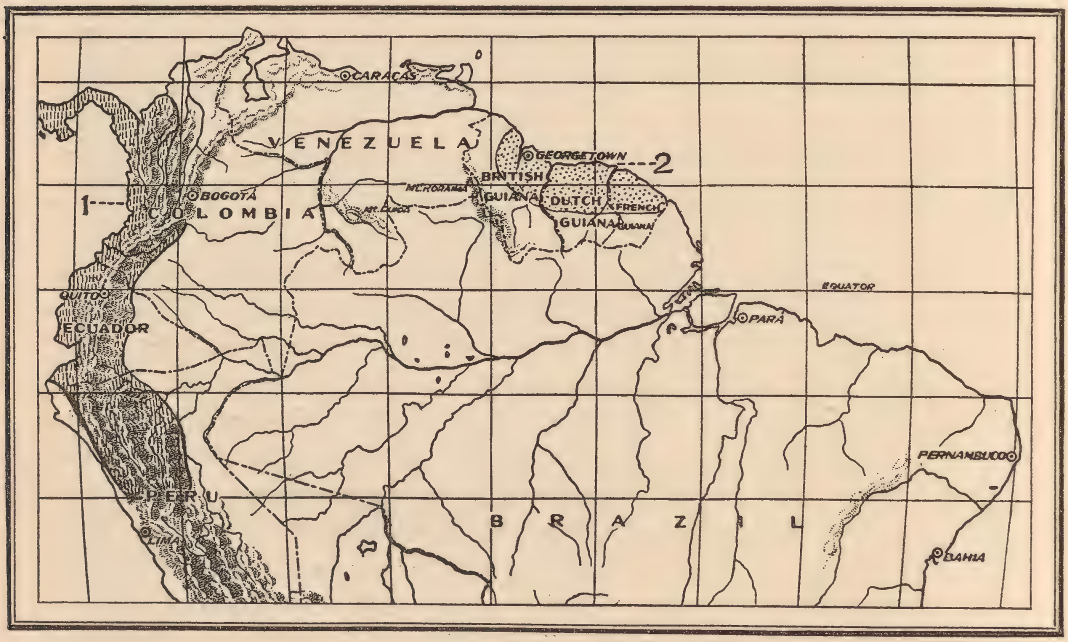


Fig. 22. 1, *Microsciurus*; 2, *Sciurillus*.[1]

western divisions of the continent. The distribution of the genera and species may be briefly stated as follows, premising that the Caribbean border of the continent is to be regarded as part of the western division.

Two very obvious characteristics of the sciurids of South America, the number of premolars and the number of mammæ, as noted in the early part of this paper (pp. 158, 159), present great constancy throughout vast geographic areas. All the groups with 6 mammæ are restricted (with the one

[1] The accompanying distribution maps (Figs. 22–25) are of course to be taken as only approximate, and largely hypothetical so far as the exact boundaries of the areas are concerned, being diagrammatic expressions of our present knowledge of the subject.

exception of the genus *Sciurillus*, to be further noticed later) to the Caribbean border and the Andean region. They include the genera *Microsciurus*, *Mesosciurus*, *Notosciurus*, and *Leptosciurus*. The squirrels with 8 mammæ occupy exclusively all the rest of the squirrel-inhabited parts of the continent, from the eastern slope of the Andes to the Atlantic coast. They include the genera *Guerlinguetus*, *Hadrosciurus*, *Urosciurus*, and *Simosciurus*, in other words, the guerlinguets and the 'giant' squirrels. *Simosciurus*, a member of the latter, however, presents a partial exception, having penetrated to the Pacific slope along the Ecuador-Peru boundary.

All South American squirrels have the premolar formula $\frac{1}{1}$, except the genera *Microsciurus* and *Sciurillus*, which have the premolar formula $\frac{2}{1}$.

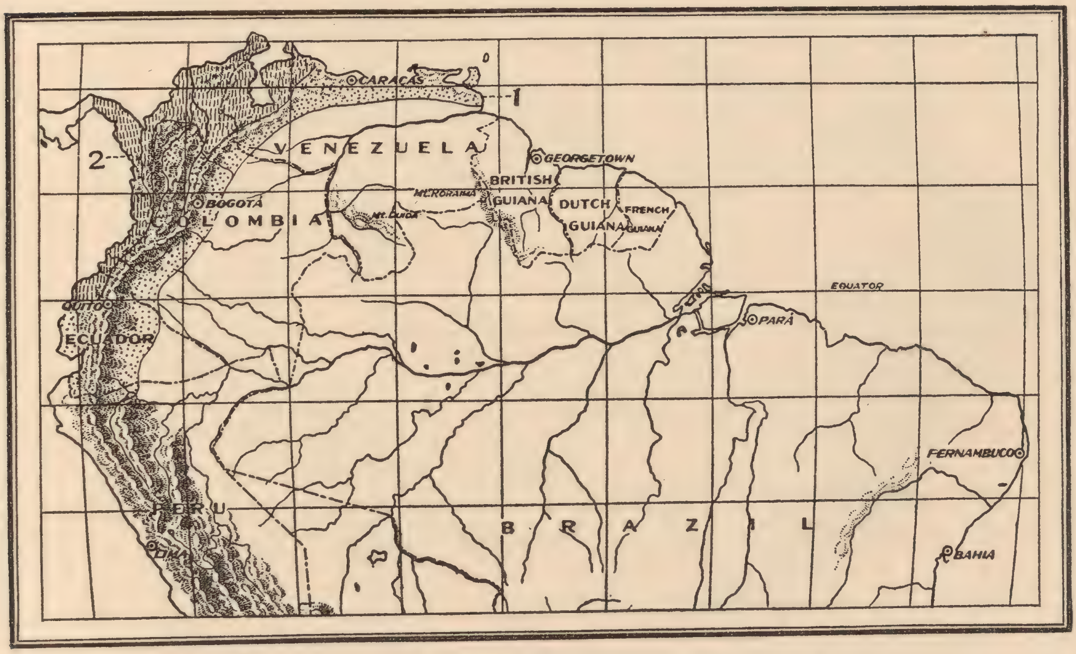


Fig. 23. *Mesosciurus*. 1, Subgenus *Mesosciurus*; 2, subgenus *Histriosciurus*.

Microsciurus ranges from Costa Rica to southern Peru, but is confined in South America to the Andean or Cordillera region, and in Colombia to the western part of this area, it not extending to the Eastern Andes, and being absent from the Bogotá region and the Merida and Maritime ranges of Venezuela. Its altitudinal range in western Colombia is from sea level to paramo. *Sciurillus*, on the other hand, is known only from the Guianas, and from only a few specimens, and is hence unrepresented in nearly all museums. It is a very ancient type, has no close relationship with any other American genus, and is among the smallest of known squirrels. Its affinities are with the Nannosciurinæ, to which it has been referred by Thomas (see *antea,* p. 190). The only other known representatives of this sub-family occur in the Malay Archipelago and in West Africa. Its presence on the east coast of South America therefore may be taken as possibly another indication of former land connection between South America and Africa.

The genera will now be briefly reviewed with reference to their constituent groups and their distribution and interrelationships.

Microsciurus is represented by nearly 20 rather closely allied forms, most of them rated as species. They are all very small, the difference in size between the largest and smallest being but little greater than the range

Fig. 24. 1, *Hadrosciurus*; 2, *Urosciurus*; 3, *Simosciurus.*

of individual variation in a good series of almost any of the species. In coloration and in the character of the pelage there is little diversity, and in the case of the latter the difference is correlated with sea level and high altitude environment. It differs widely from all other generic groups of American squirrels, and is the only South American genus (*Sciurillus* excepted) with two upper premolars. Its peculiar geographic distribution has already been stated. It may be considered as an old generalized type.

Mesosciurus has the widest distribution of any of the South American genera, it having representatives in Central America as far north as Costa

Rica, and an outlying form (*Mesosciurus richardsoni*) in Nicaragua. It occupies all of the Andean region south to Peru, and extends east in the Caribbean coast region to Trinidad. It comprises three quite distinct groups, as (1) the *hoffmanni* group, (2) the *gerrardi* group, and (3) the *saltuensis* group, no one of which overlaps the range of either of the others,

Fig. 25. 1, *Notosciurus*; 2, *Leptosciurus pucheranii* group; 3, *L. ignitis* group; 4, *L. leucogaster*; 5, *Guerlinguetus æstuans-alphonsei* group; 6, *G. ingrami.*

so far as is now known. The *hoffmanni* group (subgenus *Mesosciurus*) consists of a large number of forms (species and subspecies) all below medium size, and practically all of the same size, of the same general character of pelage, and of the same general style of coloration. The wide range of individual differentiation in size and coloration renders difficult the satisfactory discrimination of local forms. True *hoffmanni* is found in the mountainous parts of central Costa Rica, and has a barely recognizable lowland form in Costa Rica and Chiriqui. South of Chiriqui there is a hiatus in its range, it next appearing in the Western Andes of Colombia, and it occurs thence throughout all the western and central Andean range to southern Ecuador, with a lowland form along the coast of Ecuador. The mountain form of the Western Andes is not satisfactorily distinguishable from specimens from the Irazú region of Costa Rica. In the northern part of the Central and in the Eastern Andes in Colombia, true *hoffmanni* breaks up into several distinguishable local forms, some of which approach, and may intergrade with, *griseogena* of the Sierra de Merida and Sierra de Mer of Venezuela, which in turn is not greatly different from *chapmani* of the Paria Peninsula and the Island of Trinidad. There is a slightly differentiated form of *chapmani* in Tobago Island, and another strongly specialized form in Margarita Island. This latter differs so widely in coloration from any of the mainland forms as to indicate its long isolation.

The *hoffmanni* group is thus a group of wide dispersion and of very numerous forms, and perhaps may be regarded as one of the oldest groups of South American squirrels. Within its range are included the range of the genus *Microsciurus* and part of the range of the genus *Leptosciurus*.

The *gerrardi* group of the genus *Mesosciurus* (subgenus *Histriosciurus*) consists of a large number of forms of much larger size than the squirrels of the *hoffmanni* group, and of much more restricted distribution. They differ from the latter not only in conspicuously larger size, but in markedly different coloration and pelage. They are as remarkable for inconstancy of characters, particularly in coloration, as are the members of the *hoffmanni* group for constancy to a general type. The range of the *gerrardi* group is the western slope and adjoining lowlands of the Western Andes, from sea level to about 5000 feet, from northeastern Ecuador to Panama and the lowlands of the Caribbean drainage of Colombia, east to a little beyond the Venezuelan border. Not only do the extreme phases of the *gerrardi* group differ widely, especially in coloration, but specimens, with the exception of two Panama forms, of the same form from the same locality vary so much that hardly two can be found that are closely similar. It is obviously a highly plastic group, of probably comparatively recent evolution, and confined mainly to the humid tropical zone. So far as known, no two forms of, respectively, the *hoffmanni* and the *gerrardi* groups occupy the same areas, although the boundaries of the ranges of the two groups must practically adjoin each other along the western slope of the Andes for nearly a thousand miles. The only other group of squirrels that shares the habitat of the *gerrardi* group is the genus *Microsciurus*.

The third or *saltuensis* group of *Mesosciurus* was formerly known only from the small physiographically isolated area of the Santa Marta district of northeastern Colombia, where it ranges from sea level to about 9000 feet, with a lowland and a highland subspecies. The American Museum expeditions have now shown that a form of this group occurs on the lower Rio Cesar, the principal river draining the Sierra de Santa Marta region. Another widely isolated species occurs in central Peru, which so closely resembles the Santa Marta forms that, if their ranges were contiguous, it might perhaps be regarded as merely a subspecies of the Santa Marta group. The members of the *saltuensis* group agree in size with the forms of the *gerrardi* group, but differ widely from them in color and in the character of the pelage, which is long, soft, and full in the *saltuensis* group and thin, short, and hispid in the *gerrardi* group, in accordance with the contrasted environment of the two groups — temperate and humid tropical, respectively. The contrast in color in the two groups is striking, the ventral surface being deep red in all the forms of the *gerrardi* group and white in the *saltuensis* group, except that in the Peruvian form (*Sciurus pyrrhinus* Thomas) it may be either white or red or mixed white and red. The coloration of the upperparts in the two groups is equally distinctive, yet they are so closely related in all essential characters that the two groups must have had a common origin or have been derived the one from the other, with probably the *saltuensis* group as the older of the two. Both groups belong to the subgenus *Histriosciurus*.

The genus *Leptosciurus* is a small group of squirrels but little exceeding in size the larger forms of the genus *Microsciurus*, two of the three known species greatly resembling the *Microsciuri* in external features, but differing from them and from the *Mesosciuri* in the shape of the skull and in tooth structure. The range of *Leptosciurus* is discontinuous, occupying two, and perhaps three, separate areas; one in Colombia and one in the Andes of southern Peru and Bolivia. The northern area comprises nearly all of the Colombian Andes, where it is represented by four known forms, three of them closely related, the other possibly specifically separable. The genus is not known from Ecuador, and has not been met with in northern Peru, its known range in the south being an area in the high Andes of southern Peru and the adjoining Andean portion of Bolivia, trending northwest-southeast, about 500 miles long and approximately half as wide. Here it is represented by a single species, quite distinctly related to the forms of the Colombian Andes.

Another area in eastern Bolivia is occupied by a species here referred to *Leptosciurus* (the *Macroxus leucogaster* Gray), found at much lower altitudes in the Santa Cruz de la Sierra region, from which only it is thus far known. It is an aberrant member of the genus, exceeding the others in size, with a harsher pelage and quite different coloration. In cranial and other essential characters, as the shape of the skull, the structure of the teeth, and the presence of only 6 mammæ, it agrees with the other members of the genus. It is further peculiar in that it is the only known species with 6 mammæ that has invaded the great Amazonian area otherwise occupied exclusively by squirrels with 8 mammæ. It possibly may be looked upon as a comparatively recent intrusion from the west of an otherwise strictly Andean genus.

Still another Andean genus of the group of squirrels with 6 mammæ is the recently discovered *Notosciurus* (see *antea*, pp. 209–211), thus far known only from a single specimen from northern Ecuador. It is similar in general appearance to the *hoffmanni* forms of *Mesosciurus*, with which it agrees in general coloration and tooth structure, but differs in the form of the skull and in the character of the feet.

The squirrels with 8 mammæ comprise two very distinct groups, the small guerlinguets and the large so-called 'giant' squirrels. The first consists of the single genus *Guerlinguetus*, while the other comprises three groups of generic or subgeneric value, according to the viewpoint of valuation. They are here recognized as generic, though they are all much more closely related *inter se* than they are to any other group.

Guerlinguetus has a wide range, occurring in the lowlands bordering the Guiana Highlands, south along the Atlantic coast to at least Pernambuco, and in the lowlands of the Orinoco and the Lower Amazon. How far westward it ranges in the drainage of these two rivers is unknown. It has been recorded from the Upper Orinoco as far as the Rio Cunucunumá (near Mt. Duida), from the lower Rio Negro, the Rio Branco, the Rio Tocantins, the lower Rio Madeira, and the Lower Amazon. In the Brazilian Highlands, south to São Paulo and Paraná, *Guerlinguetus* is represented by a highly aberrant form (*Sciurus ingrami* Thomas), perhaps subgenerically separable from the numerous forms of the Amazonian and Orinoco lowlands. As most of this vast, more or less elevated region is open country, the single species of squirrel known to inhabit it is locally distributed, occurring only where forested areas offer a congenial habitat. It has a fuller and softer pelage than the forms of the other group, somewhat larger size and a somewhat differently proportioned skull, differences for the most part plainly correlated with the very diverse conditions of environment of the two groups.

The giant squirrels differ from the guerlinguets not only in size, in coloration, in the character of the pelage, especially in the possession of a very bushy tail, but in the shape of the skull and the character of the dentition. The distribution of the group as a whole is also very different, it being almost confined to the drainage of the Amazon and its tributaries and the middle and upper parts of the Orinoco drainage. So much of this region is still unexplored that the continuity of the range is at present largely unknown. I have seen no specimens from, nor have I found a record of any taken in, the delta region of the Lower Amazon, or even below the mouths of the Rio Madeira and Rio Negro. Thence northward and westward there is reason to suppose that the distribution of the group embraces practically the whole of the vast woodlands of the Amazonian drainage, even to the sources of its tributaries in the eastern base of the Andes, from southeastern Colombia to Bolivia, and also across the low divide to the upper sources of the Rio Paraná.

Most of the forms of the giant squirrel group belong to the genus *Urosciurus*, with three outlying groups, each consisting of a single species. These are *Hadrosciurus*, comprising the isolated *Sciurus flammifer* Thomas along the Middle Orinoco; *Simosciurus* (*Sciurus stramineus* Eydoux and Souleyet, and its subspecies), occupying a small area on the western slope of the Andes in southern Ecuador and northern Peru; and the *Sciurus langsdorffii* group of the Paraná-Tapajos divide and the sources of the Rio Marmore in Bolivia. The latter is much less aberrant from typical *Urosciuri* than either *Hadrosciurus* or *Simosciurus*. It is evident that the latter long ago found its way to the western slope from the Amazonian basin to the area bordering the Gulf of Guayaquil, and has since become strongly specialized through isolation and marked change in environment, shown in the form of the skull and the character of the teeth as well as in pelage and coloration.

Phylogenetic Considerations.

It is perhaps futile to attempt to formulate the phylogeny of the South American squirrels *inter se*. It is, however, pretty clearly evident that the Sciuridæ, including the tree squirrels, reached North America from Asia. The marmots have penetrated southward in North America to a much less extent than the spermophiles and ground squirrels, which, so far as known, have never passed beyond the Mexican plateau. The tree squirrels occupy all of North America from the northern limit of tree growth to Panama, and extend thence southward through the tree-covered parts of South America to 32° south on the Atlantic border, but only to about 15° south on the Andean side. Two genera, *Microsciurus* and *Mesosciurus*, are apparently intrusive into Central America, as there is no North American type to which they are closely related, or from which their immediate origin can be suggested. As already said, *Microsciurus* is *sui generis; Mesosciurus* is the only genus south of the Mexican plateau with the premolar formula $\frac{1}{1}$; and the only other genera of Central America, or of North America, with 6 instead of 8 mammæ are *Microsciurus, Syntheosciurus* (the latter known only from the mountains of Chiriqui), and *Baiosciurus* of Nicaragua and eastern Mexico, north to Tamaulipas. *Syntheosciurus,* with its grooved upper incisors, two upper premolars and rather peculiar skull, is not closely related to *Mesosciurus.* The only point of close agreement between *Baiosciurus* and *Mesosciurus* is in the number of mammæ, which is insufficient to outweigh the other differences between them. *Baiosciurus* superficially recalls *Leptosciurus,* but in essential characters they are widely dissimilar. Finally then we may conclude that the South American genera at present resident along the direct highway of migration between North and South America were disintegrated from the primitive stock and received their present impress long ages ago.

Guerlinguetus, aside from the difference in the mammæ formula, is not so very unlike the *hoffmanni* section of *Mesosciurus,* these two types being quite similar in tooth characters and in the general form of the skull. *Guerlinguetus* has developed a relatively much longer tail, and a quite different pelage in the typical forms, the latter readily explainable on the basis of the very different environment of the two groups. These two genera could have originated, at no very remote date, from a common ancestral type.

The giant squirrels of the Amazonian lowlands may well be supposed, on geological and geographical grounds, to be of more recent origin than the forms of the older land surfaces of South America; yet the element of migration is a possible source of grave uncertainty. From the viewpoint of present evidence, the large squirrels of the Amazonian woodlands may be said to resemble, superficially at least, the fox squirrels (genus *Parasciurus*) of middle North America (mainly southern United States and Mexican tableland), as in size, proportions, the heavy bushy tail, the possession of only one upper premolar and 8 mammæ, and still further in the elongate, low-crowned skull. On the other hand, they differ quite strongly in tooth structure, the teeth being heavy and strong, with well-developed cusplets on the outer border of the upper molars in *Parasciurus,* with all these conditions reversed in *Urosciurus* and its near affines in South America. On the other hand, the differences are far greater between *Urosciurus* and the various types of North American and Central American squirrels with the premolar formula $\frac{2}{1}$ than between *Urosciurus* and *Parasciurus.* We are left then to the supposition of an early extended migration of an original stock from North America to Brazil, with subsequent essential modification, or the supposition of an evolution from some early type or types from which the other existing South American genera of squirrels have been derived — with always the exception of *Sciurillus!*

In brief, the most that can be assumed with any degree of certainty is that the present highly varied South American sciurid fauna (with one exception) reached its present dispersion through the early migration from North America of some ancestral type. The case of *Sciurillus*, so different from all other American forms, and so similar to East Indian and West African types, can hardly be accounted for on any theory of parallel development, its differences from any other American type being so varied and profound, and so fully in agreement with a possible African ancestor.

ADDENDA.

Since the foregoing pages were made ready for the press an important collection of mammals and birds has been received from the Antioquia district of western Colombia, a region previously unrepresented in the mammal and bird collections of the American Museum. This collection was made by Leo E. Miller and Howarth S. Boyle, in continuation of the Museum's explorations in western Colombia, November to March (both months inclusive), 1914–1915. Among the 200 or more mammals obtained are 46 squirrels, collected at the following localities; Santa Elena, Barro Blanco, and La Frijolera, in the Central Andes, in the vicinity of Medellin, at altitudes of 5000 to 9000 feet; Puerto Valdivia (altitude 360 feet), on the lower Rio Cauca; Malena (altitude 1000 feet), near Puerto Berrio, on the Rio Magdalena; Alto Bonito (altitude 1500 feet) and Dabeiba (altitude 2000 feet), on the headwaters of the Rio Sucio, on the Pacific slope. This collection affords such important information on the squirrels of the Antioquia district that it seems desirable to summarize it in the present connection.

Page 192. **Microsciurus otinus** (Thomas). Type locality, "Medellin." Six specimens: Puerto Valdivia (alt. 360 ft.), 3; Alto Bonito (alt. 1500 ft.), upper Rio Sucio, 4. These specimens are the first of this species to reach the American Museum.

Page 201. **Leptosciurus pucheranii medellinensis** (Gray). Seven specimens: Barro Blanco (alt. 7200 ft., just above Medellin), 4; Santa Elena (alt. 9000 ft., also near Medellin) 3. These specimens are practically topotypes of *medellinensis*, not previously represented in the American Museum collection.

Page 203. **Leptosciurus pucheranii salentensis** (Allen). Eight specimens, all from La Frijolera (alt. 5000 ft., just above Puerto Valdivia).

These specimens are provisionally referred to *salentensis*, but they all have the black dorsal band more strongly developed than the type series of that form. In other features of coloration they are closely similar to typical *salentensis*.

Page 222. **Mesosciurus hoffmanni quindianus** (Allen). Six specimens: Barro Blanco, 3; Santa Elena, 2; Malena, 1.

These specimens extend the range of *quindianus* in the Central Andes considerably to the north of previous records.

Pages 236–240. The receipt of 6 specimens of *Mesosciurus hoffmanni quindianus* from the immediate vicinity of Medellin, and of no specimens of the *Mesosciurus gerrardi* group from the Medellin region, renders it quite certain that the type locality of *Sciurus gerrardi* Gray, from "New Grenada," was *not* the vicinity of Medellin as assumed by me as probable on p. 236 of this paper. Furthermore, the present Antioquia collection contains 12 specimens of the *gerrardi* group from the immediate vicinity of Puerto Valdivia, on the lower Rio Cauca, which are not the form described and figured by Gray as *S. gerrardi*. On the other hand (see below), the series of the *gerrardi* group collected on the upper Rio Sucio (Pacific slope), at and near Dabeiba, is referable to my *M. gerrardi salaquensis*, which has no black tail-tip, and the limbs, shoulders and sides of the body are not red as represented in the description and colored figure of *gerrardi*, which represent a form more closely resembling *M. gerrardi zuliæ* (Osgood) than any other member of the group at present known to me. I now believe that the type locality of *gerrardi* is somewhere between the ranges of the *zuliæ-cucutæ* group of this paper and the form described below as *baudensis*, in northern Colombia, and that it is a direct connectant between them. A single specimen from Rio San Jorge (No. 32701), with the tip of the tail lost, but which apparently must have been black, conforms in nearly all particulars, even to a nearly white belly, with the requirements of true *gerrardi*, and also geographically with the type region now suggested.

The specimens referred above (p. 239) to *gerrardi* I now find represent two quite distinct forms of the *gerrardi* group, both quite different from true *gerrardi*, as follows:

Mesosciurus gerrardi baudensis subsp. nov.

Mesosciurus gerrardi gerrardi Allen, *antea*, p. 236, part.

Type, No. 33180, ♂ ad., Baudo (alt. 3500 ft.), coast region of western Colombia, July 16, 1912; Mrs. E. L. Kerr.

Back, from the shoulders to the base of the tail, with a broad area of intense glossy black, which extends also over the basal third of the upper surface of the tail; rest of the tail above deep red, without a black tip; fore limbs, shoulders and sides of the body deep red, which color extends along the lower edge of the flanks to the front of the thighs and hind limbs; the intermediate region between the black dorsal area and the red of the lower border of the flanks is grizzled ochraceous and black; whole ventral surface dark red; lower surface of tail black for the basal third, grizzled more or less with orange, the rest dark red, the hairs broadly banded mesially with black, the black usually showing more or less at the surface.

Represented by two specimens from Baudo, 1 from Bagado, 1 from Juntas de Tamaná (the latter not typical).

Intergrades with *M. g. choco* to the northward along the coast, with *salaquensis* in the interior, and with *milleri* to the southward.

Mesosciurus gerrardi valdiviæ subsp. nov.

Mesosciurus gerrardi gerrardi ALLEN, *antea*, p. 236, part (only the Valdivia specimens).

Type, No. 37674, ♀, ad., Puerto Valdivia (alt. 360 ft.), lower Rio Caura, Dec. 23, 1914; Leo E. Miller.

Similar in general coloration to *M. g. choco*, but without a black tail-tip. Upperparts finely grizzled black and ochraceous, giving the general effect of blackish finely punctated with yellowish; whole of the mid-dorsal region much darker than the flanks, ochraceous prevailing on the sides; ventral surface, including inside of limbs, reddish orange; fore limbs and feet externally reddish orange, usually extending upward over the shoulders; hind limbs externally like the flanks; tail above blackish for the basal fourth, the rest red at the surface, including the tip; under surface of tail centrally grizzled black and ochraceous, broadly fringed with red, and with a broad submarginal band of black. Type (collector's measurements), total length, 468 mm.; head and body, 250; tail vertebræ, 218; hind foot, 59.

Puerto Valdivia, 6 specimens; Frijolera (near Puerto Valdivia, alt. 5000 ft.), 6 specimens.

Strongly resembles dark specimens of *M. g. choco* of the Panama region and adjoining west coast district of northern Colombia, but is darker, with the ochraceous tipping of the hairs of the upperparts much shorter, and the tail without the broad black tip characteristic of *choco*. The series of 12 specimens is very uniform in coloration and other features.

Page 245. **Mesosciurus gerrardi salaquensis** (*Allen*). Seven specimens: Alto Bonito (headwaters of Rio Sucio, alt. 1500 ft.), 3; Dabeiba (alt. 2000 ft., near Alto Bonito), 4.

These specimens agree well with the type series of *salaquensis*, and extend the known range of *salaquensis* southeastward to Dabeiba.

56.9.61c (1181 : 78.7)

Article IX.— A REVISION OF THE LOWER EOCENE WASATCH AND WIND RIVER FAUNAS.

By W. D. Matthew and Walter Granger.

Part II. ORDER CONDYLARTHRA, FAMILY HYOPSODONTIDÆ.

By W. D. Matthew.

In the present revision the Condylarthra were assigned to Mr. Granger, the Insectivora, including Hyopsodontidæ to Dr. Matthew. The transfer of this family to the Condylarthra was not decided upon until after the detailed studies were completed; it appeared advisable therefore to place it in a separate section from the Phenacodontidæ and Meniscotheriidæ revised by Mr. Granger.

Following is the diagnosis of the order as here understood:

Order Condylarthra. Herbivorous or omnivorous placentals with complete dentition, five-toed feet, ball-and-socket ankle joint and small brain. Upper molars low-crowned, rounded trigonal or quadrate with five or six principal cusps, the para- and metaconule distinct or strong; lower molars with four principal cusps, trigonid not elevated; third lobe of m_3 short or absent. Posterior premolars simple or progressively molariform; anterior premolars, canine and incisors simple, little differentiated, usually in continuous series. Humerus with supratrochlear vacuity and entepicondylar foramen. Ulnar shaft wide and stout; a third trochanter on femur; fibula complete, wholly separate from tibia. Carpal bones moderately displaced (becoming nearly serial in *Phenacodus*); tarsals serial. Astragalus with distinct neck and ball-head, astragalar foramen present except in later Phenacodonts. Manus and pes mesaxonic, pollex and hallux not opposable. Phalangeal joints more or less distinctly of hinge type; unguals narrow, claw-like, or broadened into flat hoofs.

Five families are at present included, the fifth provisionally.

1. *Mioclœnidœ.* Bunodont; hypocones of upper molars absent or rudimentary; premolars simple. Unguals unknown. *Paleocene.*
2. *Hyopsodontidœ.* Bunodont, cusps round-conic, hypocones of upper molars progressively strong, lower molar cusps alternating; posterior premolars progressively complex. Unguals claw-like. *Lower to Upper Eocene.*
3. *Phenacodontidœ.* Bunodont, with tendency to polybuny, or sublophodont. Hypocones of upper molars strong, cusps of lower molars opposite; posterior premolars progressively complex. Unguals progressively broadened into hoofs. *Paleocene and Lower Eocene.*

4. *Meniscotheriidæ.* Lophoselenodont; first two upper molars quadrate, hypocones united with metaconules into a crest, remaining cusps crescentic; last upper molar triangular, no third lobe in last lower molar; premolars progressively molariform. Unguals narrow hoofs. *Lower Eocene.*

5. *?Pleuraspidotheriidæ.* Bunoselenodont with two conical outer cusps and two crescentic inner cusps, conules vestigial; premolars progressively molariform. Astragalus with broad trochlea and short neck; unguals narrow hoofs. *Paleocene.* Systematic position doubtful; placed here on Schlosser's authority.[1]

A number of South American genera, mostly from the Notostylops beds, have been referred to the Condylarthra by Ameghino and other authorities. Some of them may belong to this order, but their family reference is uncertain.

Family HYOPSODONTIDÆ.

The position of this family was discussed at some length by Matthew in 1909.[2] The family was not then removed from the Insectivora, where it had been placed by Wortman [3] and Loomis,[4] but the discussion of its relationship concluded with the statement: "Nevertheless I believe that its affinities are in reality closer to the Condylarthra than to the more typical Insectivora."

Additional skeleton material of *Hyopsodus,* including a well preserved hind foot, serves to confirm the above somewhat tentative conclusion, and makes it advisable to remove the family to the Condylarthra. Its position in the Insectivora has always been anomalous, and could only be defended by regarding this order as a sort of catch-basket for primitive unspecialized placentals that could not be placed elsewhere. It also involved difficulties as to the position of the Mioclænidæ, which while generally regarded as primitive Condylarthra appeared to be nearly allied to the Hyopsodontidæ.

The astragalus, while very primitive, is distinctly of the type peculiar to primitive Carnivora and Condylarthra, as opposed to the characteristic form of the Insectivora or that of the primitive Primates. The teeth exclude it from the Creodonta. In teeth, skull and skeleton characters it compares best with the most primitive among the Condylarthra, and the ungual phalanges, while they are claws rather than hoofs, are but little different in type from those of *Tetraclænodon.* The only character somewhat difficult to reconcile with condylarthrous affinities is the short pubic symphysis.

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[1] See Schlosser, 1911, in Zittel's Grundzüge der Palæontologie, zw. Anfl., II Abth., s. 439.
[2] Matthew, 1909, Mem. A. M. N. H., Vol. IX, pt. vi, pp. 508–516.
[3] Wortman, 1903, Amer. Jour. Sci., Vol. XV, p. 162.
[4] Loomis, 1907, *ibid.*, Vol. XIX, p. 417.

Haplomylus gen. nov.

Fam. ?Hyopsodontidæ.

Type, Microsyops speirianus Cope, probably from the Lower Wasatch of the Bighorn basin, Wyo.

This imperfectly known species was described by Cope from a lower jaw fragment with m_{1-3} and provisionally referred to *Hyopsodus* and subsequently to *Microsyops.* Numerous additional specimens have been secured from the Bighorn basin, and show that it represents a distinct genus.

The lower molars consist of four cusps, somewhat obliquely set, but less so than in *Hyopsodus,* lower, and with a distinctly basined heel. The last molar is considerably reduced. The fourth premolar is more compressed and elongate than in *Hyopsodus,* with the principal cusp distinctly twinned, and a sharp narrow heel, and small anterior basal cusp.

The upper teeth are of ovate-trigonal outline, with hypocone well developed but from the posterior wing of the protocone, so that it does not project postero-internally. The external cusps are rather small, with distinct para-, meso- and metastyles; the conules are small but distinct. The fourth premolar is triangular with the principal cusp central, and three minor cusps at the internal, postero-external and antero-external angles. The last upper molar is greatly reduced and simplified.

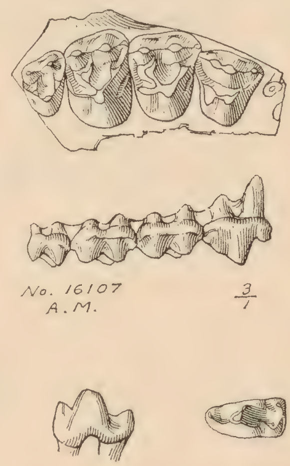

Fig. 1. *Haplomylus speirianus* Cope, No. 16107, Upper jaw and lower premolar, enlarged three diameters. Sand Coulée beds, Clark Fork basin, Wyoming.

The affinities of the genus appear to be with *Hyopsodus* and *Mioclænus.* Tarsiid relationship is improbable, judging by the compressed premolar and the general set of the molar cusps.

Haplomylus speirianus (*Cope* 1880).

Hyopsodus speirianus Cope, 1880, Amer. Nat., Vol. XIV, p. 908; (*Microsyops*) 1885, Tertiary Vertebrata, p. 216, pl. xxva, fig. 8; ("Microsyops") Osborn, 1902, Bull. Am. Mus. Nat. Hist., Vol. XVI, p. 210, fig. 37.

Type, Am. Mus. No. 4190, a lower jaw fragment with three molars preserved.

The type was originally described with other fossils as from the Wind River basin, but in 1885 the locality was definitely stated as Bighorn Valley. In cataloguing the Cope Collection in 1896 I referred this discrepancy to the collector, Dr. Wortman, who informed me that although most of his collections of 1880 came from the Wind River Valley and of 1881 from the Bighorn basin, he did obtain a few specimens in 1880 from the Bighorn which were at first wrongly supposed by Professor Cope to have come from the Wind River Valley, the error being subsequently corrected. I cite these circumstances, because later collecting indicates that this genus is wholly limited to the lower part of the Wasatch, and is a valuable horizon-indicator (leitfossil). This is equally true of *Didymictis leptomylus*, described in the same notice as *H. speirianus*, as from the Wind River. It is abundant in the lower part of the Wasatch but has not been found in the Upper Gray Bull, Lysite or Lost Cabin, where it is replaced by larger and more progressive species. The type specimens of these two species have more the appearance of specimens from the Lower Wasatch of the Bighorn basin than of specimens from the Lost Cabin or Lysite beds of the Wind River Valley.

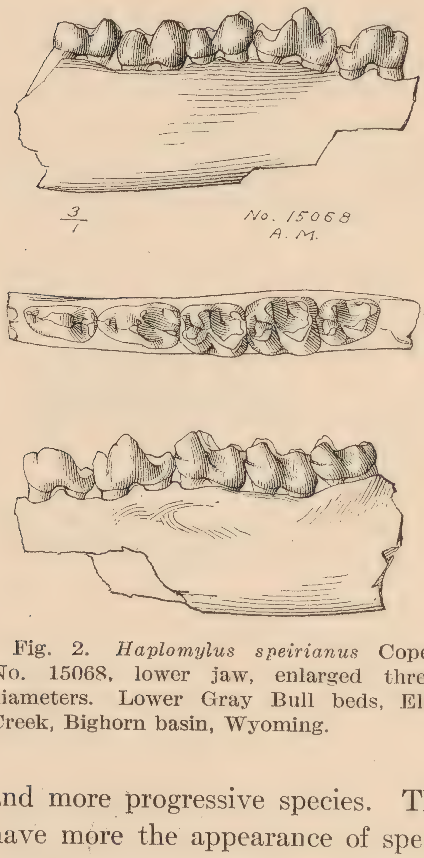

Fig. 2. *Haplomylus speirianus* Cope, No. 15068, lower jaw, enlarged three diameters. Lower Gray Bull beds, Elk Creek, Bighorn basin, Wyoming.

It appears reasonably certain therefore that the true horizon of the type of *Haplomylus speirianus* is Lower Wasatch. Of the referred specimens thirty-two are recorded from the lower Gray Bull, six from the Sand Coulée, two from the Clark Fork beds, of the Bighorn and Clark Fork basins; none from the Wind River basin. They are all parts of upper or lower jaws with more or less of the premolar and molar dentition preserved; in No. 16107 upper and lower teeth of the same individual are associated. The skull and skeleton are unknown.

Hyopsodus *Leidy* 1870.[1]

Type, H. paulus from the Lower Bridger (Orohippus zone) of Wyoming.

[1] Leidy, 1870, Proc. Acad. Nat. Sci. Phila., Vol. 22, p. 109.

Principal diagnostic characters: *skull* mesaticephalic, occiput broad, mastoid exposure considerable, lachrymal exposed upon face, lachrymal foramen within orbital rim, zygomatic arches deep, nasals not expanded posteriorly, palate not fenestrated nor extended backward nor crested on posterior margin; *incisors* unreduced, pointed, subspatulate, *canines* small, incisiform, *premolars* progressively complex, the anterior premolars, canines and incisors in both upper and lower jaw similar in size and character without diastemata, posterior premolars progressively complex in cusp constitution, submolariform; molar cusps tending to be round conical, *upper molars* six-cusped, conules prominent, hypocone progressively developed, no external styles, *lower molars* with four principal cusps partly alternating (the inner pair not opposite the outer pair), heels not basined, hypoconulids small median, heel of m_3 comparatively short; *humerus* moderately expanded distally with entepicondylar foramen and supratrochlear vacuity, shaft of *ulna* wide but thin, olecranon large, *radius* with flattened oval head; *carpals* separate, lunar-unciform contact considerable; in *pelvis* iliac bar trihedral, ischium takes little or no part in symphysis, *femur* rather short, third trochanter prominent and situated well down on shaft, tibia separate from fibula; in pes, *astragalus* with short distinct neck, flattened head, tibial facet oblique, little grooved, no inner malleolar crest, foramen distinct, *calcaneum* with slight fibular facet, *cuboid* with distinct astragalar facet facing chiefly internal, five *metatarsals*, the lateral digits unreduced, distal ends hinge-jointed, *phalanges* short, unguals claw-like, fissured, not compressed.

This genus is abundant in all the Eocene horizons above the Clark Fork. In the Clark Fork it is not found.

Although skulls and skeleton parts are rare the species are represented in our Wasatch and Wind River collections by great numbers of jaws and parts of jaws, about one thousand altogether. The chief specific distinctions are: size, length of teeth, differentiation of entoconid from hypoconulid on m_3; development of hypocone on upper molars, size of m^3 and of heel of m_3, form of $p\frac{3-4}{3-4}$ and disappearance of the basined talonid. In these characters the oldest species approach near to *Haplomylus,* while the latest species approximate those of the Middle Eocene.

The true horizons of the several Lower Eocene species have not heretofore been understood correctly, but the abundant comparative material makes them clear. The described species are as follows:

H. miticulus (Cope, 1874)	Wasatch	New Mexico.
H. mentalis (Cope, 1875)	"	" "
H. lemoinianus Cope, 1882	Bighorn basin	Wyoming.
H. powellianus Cope, 1885	" "	"
H. wortmani Osborn, 1902	Wind River basin	"
H. simplex Loomis, 1905	Bighorn basin	"
H. minor Loomis, 1905	Wind River basin	"
H. browni Loomis, 1905	" " "	"
H. jacksoni Loomis, 1905	" " "	"

All these are nearly allied to each other and to the Bridger species. *H. lemoinianus* appears to be a synonym of *H. mentalis,* and *H. jacksoni* of *H. browni.* The others are retained as species or subspecies and two new forms are added.

Osborn in 1902 pointed out the evolutionary progress observable in the species of *Hyopsodus* from successive stages of the Lower and Middle Eocene; this is in general confirmed and extended by the far larger collections now available and the somewhat wider geologic range of the genus; but it is evident that not one but three or four phyla are present in each horizon; the relations of the Lower Eocene species to those of the Middle Eocene are not wholly clear, and the geological overlap of stages of each structural phylum suggests rather progressive displacement of older by newer stages coming in from some other region, than gradual evolution *in loco.* It might equally well be interpreted as the displacement of older by newer "mutants", in the DeVriesian sense of this term.

However this may be, the Lower Eocene species are distinguished from those of the Middle Eocene by the less molariform premolars, and this is most noticeable in *H. simplex* from the lowest horizon, while the Lost Cabin species approach nearest to those of the Bridger. In *H. simplex* the hypocones of the upper molars are smaller, the lower molar heels are more distinctly basined, m^3 is small and the entoconid of m_3 is not distinct from the hypoconulid, characters lost in the later species and indicating affinities with the Paleocene Mioclænidæ, and with the more or less intermediate genus *Haplomylus.*

Ameghino [1] has referred to the Hyopsodontidæ the genus *Selenoconus* of the Notostylops horizon in Patagonia, considering it as a separable with difficulty from *Hyopsodus.* His figures and descriptions indicate, however, that the lower molars in this genus had the characteristic and peculiar construction of the Notoungulata, which I will have occasion to discuss in a later section of this revision. Schlosser [2] refers *Selenoconus* to the Archæopithecidæ, and figures the upper and lower teeth of *Oldfieldthomasia*, a closely related if not identical genus. Such resemblances as appear between this genus and the Hyopsodontidæ may perhaps indicate common descent from the Mioclænidæ but probably not any closer relationship.

Key to Species of Hyopsodus.

A. Hypocone small on m^{1-2}, absent on m^3.
  a. M^3 and heel of m_3 very small, no entoconid on m_3.
    1. $M_{1-3} = 10$ mm . . . . *H. simplex.*
B. Hypocone well developed on m^{1-2}, small on m^3.

[1] Ameghino, 1906, Anal. Mus. Nac. Buenos Aires, t. XV, (3e sér, t. VI) p. 291, figs. 72–3.
[2] Schlosser, 1911, in Zittel's Grundzüge d. Pal., Vertebrata, p. 517.

b. M^3 and heel of m_3 small, entoconid of m_3 imperfectly separate from hypoconulid

2. M_{1-3} = 11 mm. . . . . *H. miticulus*

c. M^3 and heel of m_3 large, entoconid of m_3 distinct from hypoconulid

3. M_{1-3} = 10 mm. . . . . *H. wortmani*

4. M_{1-3} = 12 mm. . . . . *H. mentalis*

C. Hypocone strong on m^{1-3}, p^4 subquadrate

d. M^3 and heel of m_3 large, elongate, entoconid of m_3 distinct

5. M_{1-3} = 18 mm.; p$\frac{3}{3}$ simpler. . . . . *H. powellianus*

6. M_{1-3} = 20 mm.; p$\frac{3}{3}$ more complex. . . . . *H. walcottianus*

D. Hypocone strong on m^{1-2}, variable on m^3, p^4 subquadrate

e. M^3 and heel of m_3 large, entoconid of m_3 distinct

Premolars more crowded, p_4 quadrangular, roots of p_2 connate or completely united. All from Middle Eocene.

7. M_{1-3} = 13 mm. . . . . *H. paulus*

8. M_{1-3} = 11 mm. . . . . *H. minusculus*

9. M_{1-3} = 12 mm. . . . . *H. lepidus*

10. M_{1-3} = 14 mm. . . . . *H. despiciens*

11. M_{1-3} = 15 mm.; deuterocone on p^2. . . . . *H. marshi*

Hyopsodus simplex *Loomis* 1905.

Hyopsodus simplex Loomis 1905. Amer. Jour. Sci., 1905, Vol. XIX, p. 419, fig. 2, type only.

Type, a lower jaw fragment in the Amherst Museum.

This species is characteristic of the red-banded basal zone (Sand Coulée beds) of the Wasatch, although the type is from the later Gray Bull horizon and does not display the primitive characters so clearly as the older specimens.

M^3 and the heel of m_3 are much reduced, hypocone weak on m^{1-2}, absent

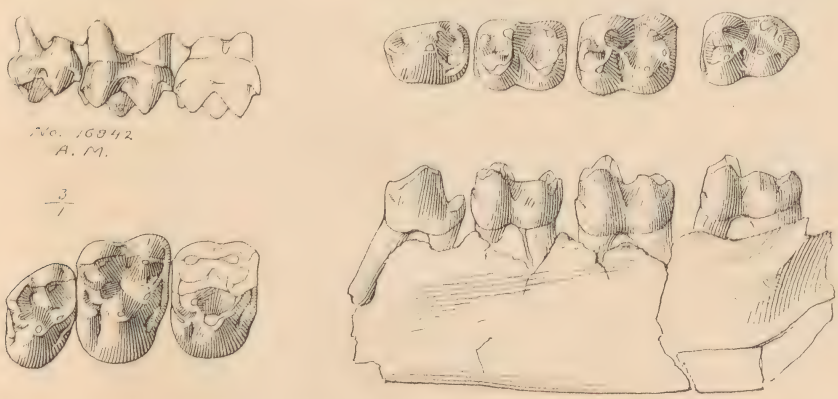

Fig. 3. *Hyopsodus simplex* Loomis, No. 16842, upper and lower jaw fragments. Sand Coulée beds, Clark Fork basin, Wyoming. Upper molars, lower molars and p_4, crown and external views, three times natural size.

on m^3, deuterocone of p^4 more triangular than in *H. miticulus* with weaker cingula on its anterior and posterior faces.

Referred specimens in Amer. Mus. Coll., Nos. 16081, anterior half of skull, 16082–7 upper and lower jaw fragments. All from Sand Coulée beds of Clark Fork basin. Length, m_{1-3} = 10–11 mm.

This species shows a marked approach to *Haplomylus,* and through that genus to the Mioclænidæ and the smaller Periptychidæ.

Hyopsodus miticulus (*Cope* 1874).

Esthonyx miticulus Cope, 1874, Rep. Vert. Foss. New Mex., p. 8; (*Hyopsodus*) 1875, Syst. Cat. Eoc. Vert. New Mex., p. 8; 1877, Rep. Vert. Foss. New Mex., p. 150, pl. xlv, figs. 10–12.—Osborn, 1902, Bull. A. M. N. H., Vol. XVI, p. 183, fig. 6.

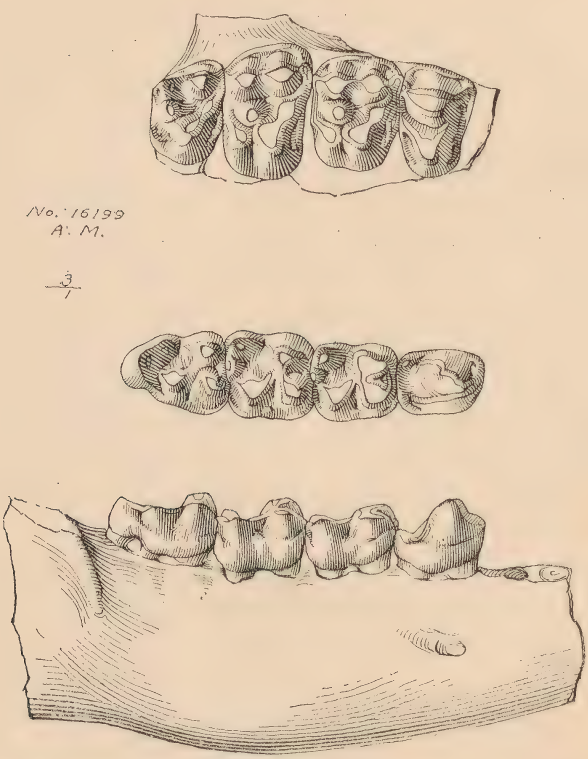

Fig. 4. *Hyopsodus miticulus*, topotype, upper and lower jaws, No. 16199. Crown views of upper and lower teeth p^4–m^3, p_4–m_3 and external view of lower jaw, all enlarged to three diameters. Almagre beds, Arroyo Blanco, Wasatch of New Mexico.

Type, a lower jaw fragment with m_{1-3}, fig. 10 of Cope's 1877 report. Not found in National Museum collection.

The species is distinguished by small size, short wide molars, short and small fourth premolar. Hypocone strong on m^{1-2} but smaller than protocone; a small hypocone on m^3. M^3 smaller than m^1, metacone usually small. Deuterocones of p^{3-4} relatively small. Entoconid imperfectly separated from hypoconulid. Length of m_{1-3} = 10.5 to 12 mm.

No. 16199, upper and lower jaws from the Almagre horizon of New Mexican Wasatch, agrees with Cope's figure and description and may serve as topotype. No additional specimens from this region, but it is very abundant in the Gray

Bull horizon of the Bighorn Wasatch. Several hundred specimens are at hand for comparison showing a considerable range in size, and variation in various characters, but fairly constant in those cited above.

Hyopsodus mentalis *Cope* 1875.

Antiacodon mentalis Cope, 1875, Syst. Cat. Eoc. Vert. New Mex., p. 17; (*Sarcolemur*) 1877, Rep. Vert. Foss. New Mex., p. 149, pl. xlv, fig. 15.

Syn., *Hyopsodus lemoinianus* Cope, 1882, Proc. Am. Phil. Soc., Vol. XX, p. 148; Tertiary Vertebrata, p. 236, pl. xxive, fig. 9.— Osborn, 1902, Bull. A. M. N. H., Vol. XVI, p. 183, fig. 7.— Loomis, 1905, Am. Journ. Sci., Vol. XIX, p. 420, fig. 3.

Type, a lower jaw fragment with m_{1-2}, figured by Cope in 1877. Not found in National Museum collection.

No. 16194, upper and lower jaws, from the upper horizon (Largo beds)

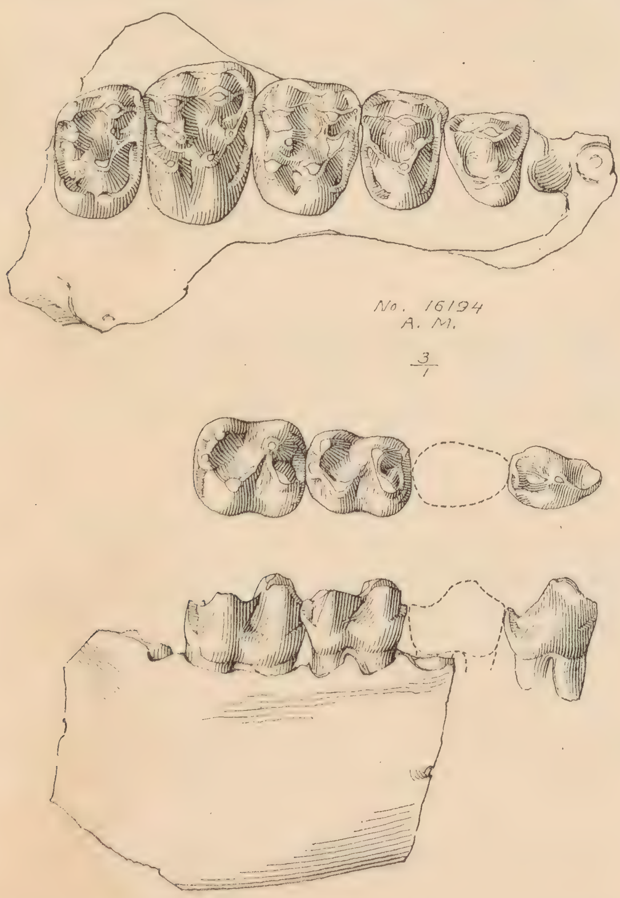

Fig. 5. *Hyopsodus mentalis* Cope, topotype, upper and lower jaws, No. 16194. Crown views of upper and lower teeth and external view of lower jaw fragment all enlarged to three diameters. Largo beds, Ojo San Jose, Wasatch of New Mexico.

of the New Mexican Wasatch, agrees with Cope's figure and description and may serve as topotype.

The species is larger than *H. miticulus,* the lower molars more elongate, the fourth premolar decidedly larger, longer and more trenchant. The hypoconulid and entoconid of m_3 are clearly distinct. M^3 almost or quite as large as m^1, hypocone distinct, and on m^{1-2} subequal with protocone. Deuterocone of p^4 as wide as protocone, on p^3 large with strong connecting crests. Length of lower molars, $m_{1-3} = 14–15$ mm.

A number of jaws from the upper and lower levels of the New Mexican Wasatch agrees very nearly with this species. There would appear to be considerable variation in certain characters. In three specimens the last upper molar has the metacone greatly reduced, in the others, as in the topotype, it is normal. In the topotype, as in Cope's type, the metaconid is indistinctly twinned, but in other specimens it is simple.

Hyopsodus lemoinianus Cope does not differ in any way from this species. The type is from the Bighorn Wasatch, horizon unknown. Loomis records the species as from the Gray Bull River, but all our typical material comes from the Lost Cabin horizon, and some if not all of his Gray Bull specimens may be from this level, others are perhaps large individuals of *miticulus.*

In the Lost Cabin horizon this species is abundant both in the Bighorn basin and in the Wind River Valley. It is represented by the smaller mutant *lysitensis* in the Lysite of both basins.

Hyopsodus mentalis lysitensis subsp. nov.

Hyopsodus lemoinianus Cope Osborn, 1902, Bull. A. M. N. H., Vol. XVII, p. 183, fig. 7a. Not the type specimen of *H. lemoinianus.*

Type, No. 15621, left ramus of jaw with $p_2–m_3$; Lysite beds, 15 Mile Creek, Bighorn basin, Wyo. Exp. 1911.

While the typical *mentalis* appears to be strictly limited to the Lost Cabin zone, a smaller form is abundant in the Lysite both in the Wind River and Bighorn basins. I regard it as a subspecies of *mentalis.*

This subspecies lies intermediate between *H. mentalis* and *H. miticulus,* both in size and progressiveness. Although chiefly found in the Lysite, it occurs more sparingly in the Lost Cabin horizon.

Hyopsodus powellianus *Cope* 1885.

Phenacodus zuniensis Cope, 1882, Proc. Amer. Phil. Soc., Vol. XX, p. 179. Not *P. zuniensis* Cope, 1881.

Hyopsodus powellianus Cope, 1885, Tertiary Vertebrata, p. 235, pl. xxiiid, fig. 3–4; Osborn, 1902, Bull. A. M. N. H., Vol. XVI, p. 184, fig. 9.
Phenacodus laticuneus Cope, 1882, in part, see infra, p.?

Type (lectotype), No. 4147, lower jaw with m_{1-3}. Horizon unrecorded, Bighorn basin, Wyoming.

Characters: M_{1-3} = 18 mm. M_3 with long heel, entoconid distinct. Hypocones of m^{1-3} strong, antero-internal cingula heavy, p^4 subquadrate. P_4 with well developed deuteroconid.

This species is very abundant in the Lysite horizon, in the Bighorn basin. So far as our material shows it is wholly confined to this level, although Loomis records two specimens from the Gray Bull (but possibly these are

Fig. 6. *Hyopsodus powellianus* Cope, topotype, upper jaw, No. 15622. Crown view of upper teeth, left side enlarged three diameters. The premolars are reversed from the right maxilla. Lysite beds, Coyote Cañon, Bighorn basin, Wyoming.

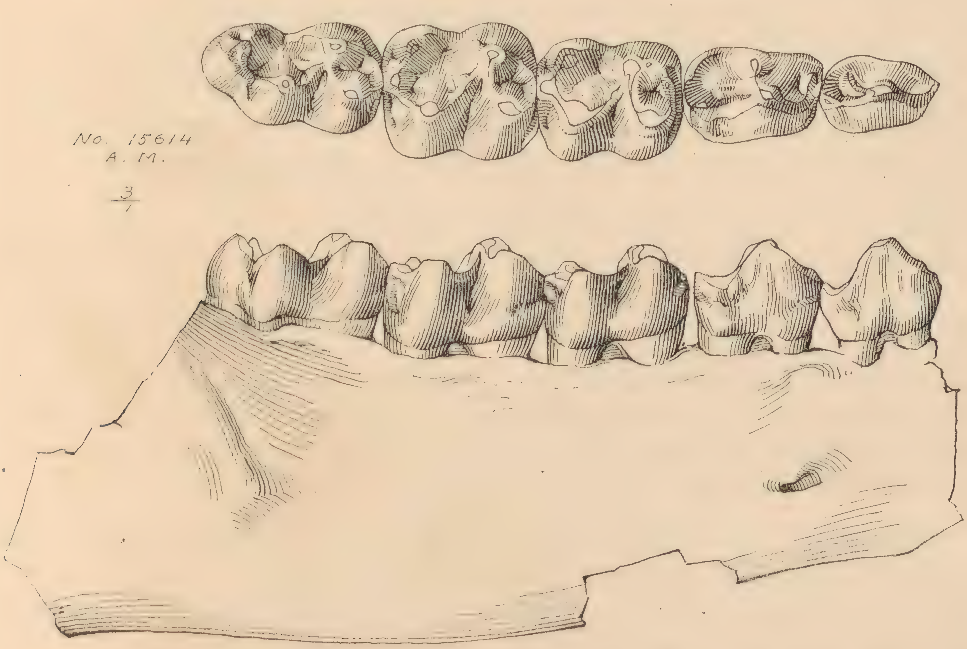

Fig. 7. *Hyopsodus powellianus*, topotype, No. 15614, lower jaw, three diameters. Lysite beds, Fifteen-mile Creek, Bighorn basin, Wyoming.

also from the Lysite). It has not been found in New Mexico. In the Wind River basin it is represented in the Lysite horizon by a nearly related but uniformly smaller variant *H. browni.*

Hyopsodus powellianus browni *Loomis.*

Hyopsodus browni Loomis, 1905, Am. Journ. Sci., Vol. XIX, p. 422, fig. 7.
Syn., *H. jacksoni, H. lawsoni* loc. cit., p. 423, fig. 8.

Type, a lower jaw fragment in the Amherst Museum.

The fourth premolar of Dr. Loomis's type is altogether exceptional in the lack of any strong deuteroconid. This is not the normal character of the species as shown by a large series of topotypes in the American Museum collection. The supposed third premolar of *H. jacksoni* ("*lawsoni*" in figure) appears to be the fourth premolar of a smaller individual. While the topotype series shows some variability in the form of m^3 and a few other characters they run fairly constant in size and in most characteristics and there is no indication of the peculiar features on which Dr. Loomis characterized these two species, and which are not normally present in any species of this genus, although they occur occasionally as abnormalities. I regard the series as representing a single subspecies intermediate in size between *H. powellianus* and *mentalis* and somewhat more primitive than either. The heel of the last molar is more elongate than in *H. mentalis,* the heel of p_3 has no inner cusp, and the size is larger. These characters ally it with *powellianus.* It is abundant in the type locality, Cottonwood Draw (Bridger Creek) in the Wind River basin, and found more rarely in the Lysite of the Bighorn basin. A few doubtful specimens are found in the Lost Cabin horizon.

Hyopsodus walcottianus sp. nov.

Type, No. 14654, upper and lower jaws, parts of limb bones and hind foot, from Lost Cabin beds, Wind River basin.

Distinctive Characters. Larger than *H. powellianus,* deuterocones of p^{3-4} more conical with no anterior crescent-wing, deuteroconid of p_4 more posterior in position, p_3 more robust, less spatulate, basal cusps of lower premolars and external styles of upper premolars more distinct. Length $m^{1-3} = 18$; $m_{1-3} = 21$ mm.

This is the largest known species of the genus, and appears to be the Lost Cabin successor of *H. powellianus* of the Lysite beds. It has therefore seemed appropriate to name it after the distinguished palæontologist who was Major Powell's successor as director of the Geological Survey.

In addition to the type, two lower jaws are referred here, one from the

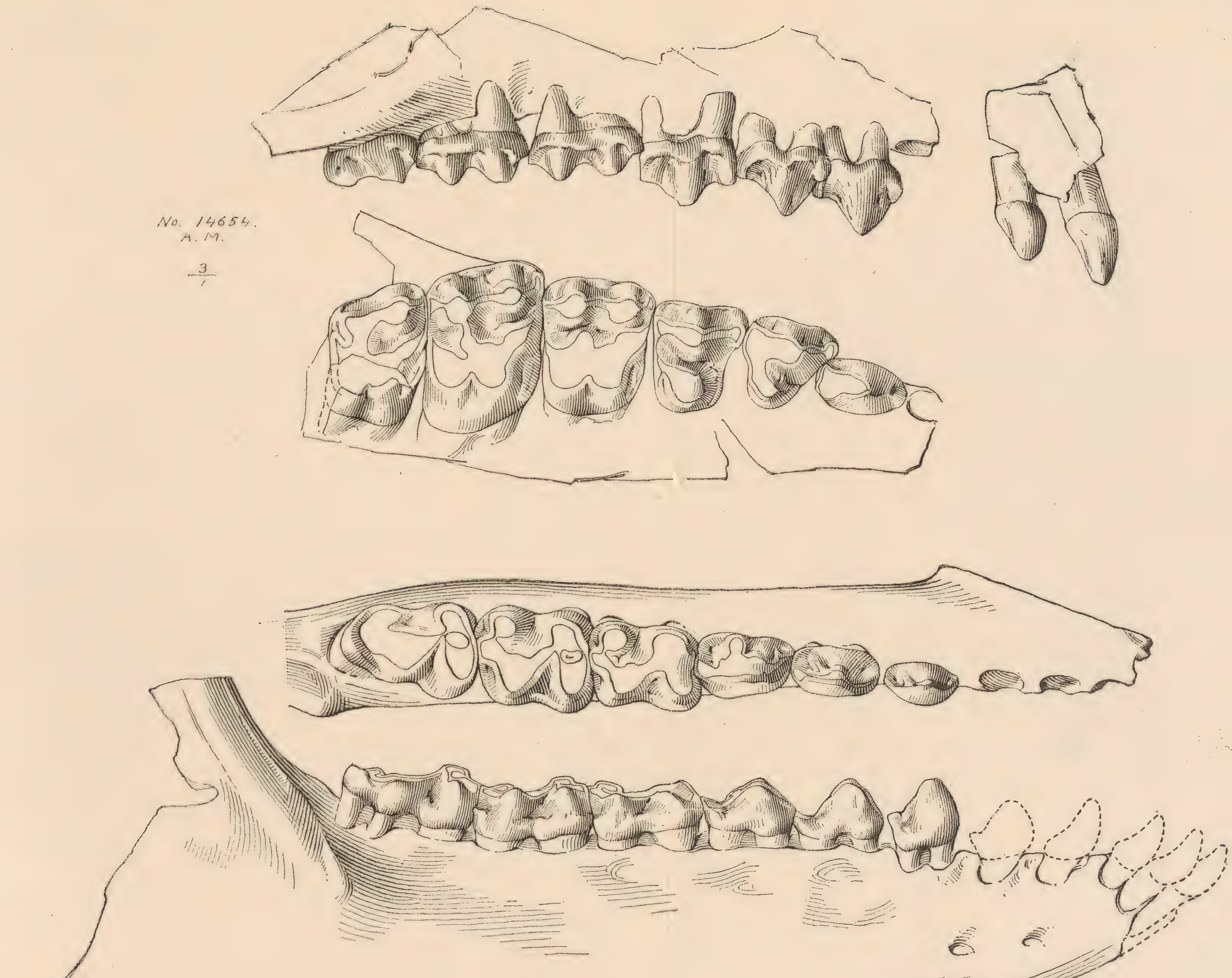

Fig. 8. *Hyopsodus walcottianus*, type, No. 14654, upper and lower jaws three times natural size. Lost Cabin beds, Alkali Creek, Wind River basin, Wyoming.

Lost Cabin horizon, at Beaver Creek divide, south of the Wind River basin, No. 14967, the other from the typical Lost Cabin beds, No. 14617. The latter is smaller but otherwise shows the progressive character of the species. Other fragmentary specimens are of doubtful reference.

The characters of limb and foot bones have been indicated in the generic diagnosis of *Hyopsodus*. Except in size and robustness I do not observe any specific distinctions in the skeleton parts from *H. paulus* as described in the Bridger memoir.

Hyopsodus wortmani *Osborn* 1902.

Hyopsodus wortmani Osborn, 1902, Bull. A. M. N. H., Vol. XVI, p. 185, fig. 11; Loomis, 1905, Am. Journ. Sci., Vol. XIX, p. 421, fig. 5.

Type, No. 4716, upper and lower jaws from the Wind River basin, Wyoming.

The lower molars are narrow and elongate, the heel of m_3 long, with entoconid well separated from metaconulid, and the last upper molar is larger than in *H. miticulus*, the size of its hypocone varying but more frequently large. The premolars are distinctly more progressive, $p\frac{4}{4}$ more quadrate in outline, with deuteroconid and deuterocone relatively larger than in the older species. From *H. mentalis* it is distinguished by smaller size and less robust form of teeth.

This form is common in the Lost Cabin horizon of the Wind River basin, while in the Lysite a smaller form, probably a subspecies, is found, and has been named *H. minor* by Dr. Loomis.

This species and *H. mentalis* are closely related to the Bridger species, *H. minusculus* and *H. paulus* respectively. The distinctions are not clear, although the Middle Eocene species average more progressive.

Hyopsodus wortmani ?minor *Loomis* 1905.

A lower jaw from the Lysite level in the Wind River Valley and another from the same horizon in the Bighorn basin indicate a little *Hyopsodus* close to *H. wortmani* in tooth characters, but of smaller size, the molars only 10 mm. In its relatively narrow, high cusped teeth, long heel of m_3 and well separated metaconid it is very different from *simplex* with which it agrees in size.

Loomis's type of *Hyopsodus minor* came from the same locality and level as these Wind River specimens and agrees in size; but Loomis describes the teeth as "short," whereas in these specimens, as in *wortmani*, they are unusually long. The identification is therefore questionable.

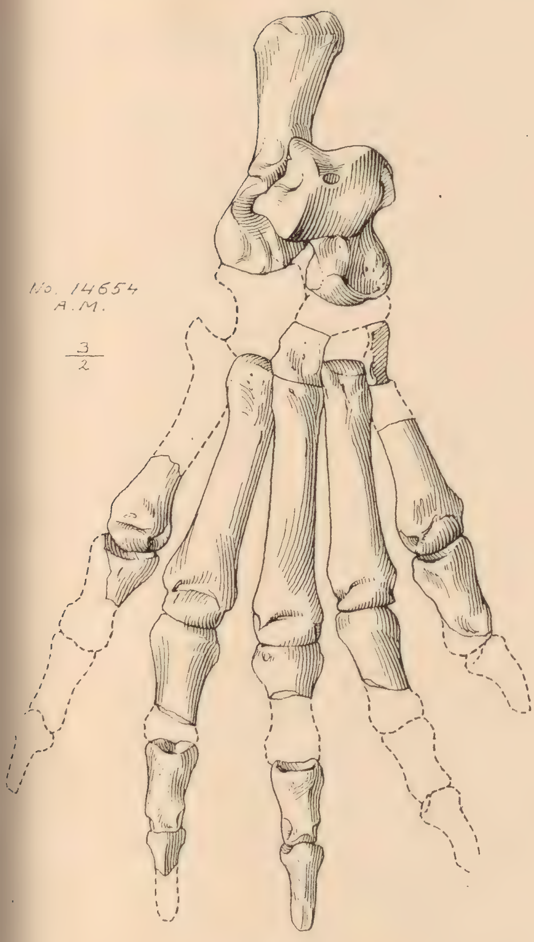

Fig. 9.

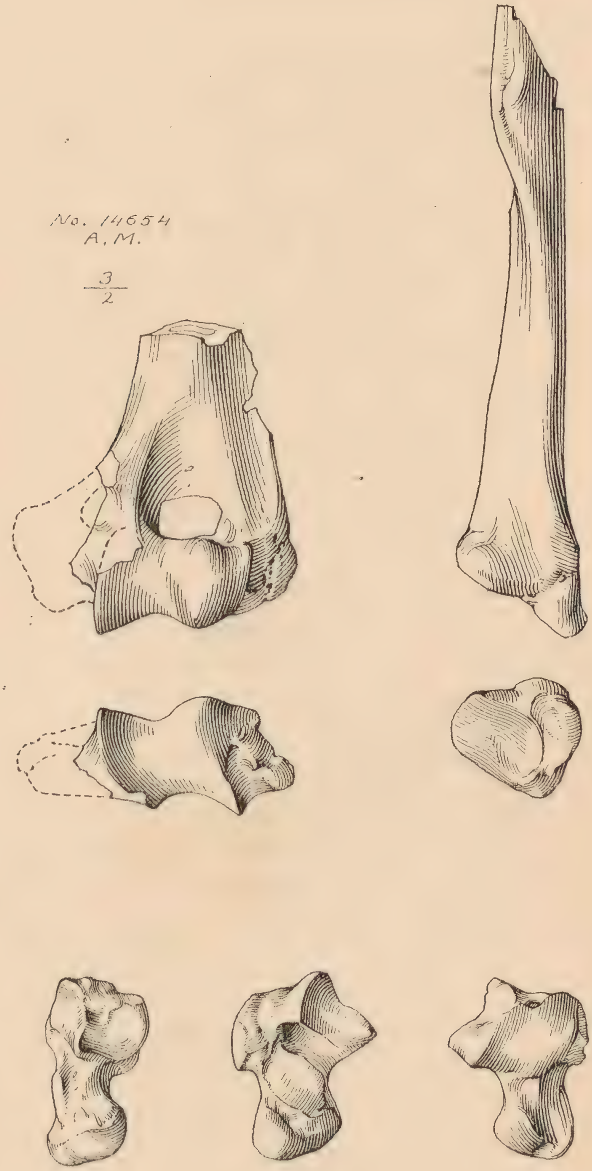

Fig. 10.

Figs. 9 and 10. *Hyopsodus walcottianus*, type, hind foot, humerus, tibia and astragalus, all one and a half times natural size. No. 14654, Lost Cabin beds, Wind River basin, Wyoming.

Geological Level and Localities of Species of Hyopsodus.

On account of their great abundance the species of *Hyopsodus* afford valuable data for correlation of the Lower Eocene formations.

Their occurrence in our collections so far as identifiable is as follows:

I.	Clark Fork basin.		
	C. Gray Bull beds (Systemodon zone)		
	H. miticulus	24	specimens
	B. Sand Coulée beds		
	H. simplex	18	"
	A. Clark Fork beds		
	No *Hyopsodus*		
II.	Bighorn basin.		
	C. Lost Cabin		
	H. walcottianus	2	"
	H. powellianus browni	1	"
	H. mentalis lysitensis	3	"
	H. wortmani	2	"
	B. Lysite		
	H. powellianus	114	"
	H. powellianus browni	2	"
	H. mentalis lysitensis	96	"
	H. wortmani minor	2	"
	A. Gray Bull beds.		
	H. miticulus	about 450	"
III.	Wind River basin.		
	B. Lost Cabin		
	H. walcottianus	3	"
	H. mentalis	50	"
	H. " *lysitensis*	17	"
	H. wortmani	14	"
	A. Lysite		
	H. powellianus	4	"
	H. " *browni*	92	"
	H. mentalis	1	"
	H. mentalis lysitensis	32	"
	H. wortmani minor	1	"
IV.	New Mexican Wasatch.		
	B. Upper zone (Largo beds)		
	H. mentalis	27	"
	A. Lower zone (Almagre beds)		
	H. mentalis	[1] 5	"
	H. " *?lysitensis*	[1] 20	"
	H. miticulus	1	"

[1] Mostly from top of lower beds.

Species of *Hyopsodus*	Sand Coulée	Gray Bull		Lysite			Lost Cabin		
	Clark Fork	Clark Fork	Bighorn	Lower Wasatch of New Mexico	Wind River	Bighorn	Bighorn	Wind River	Upper Wasatch of New Mexico
simplex	18	..	1	..	..	...	..	..	..
miticulus	..	24	450	1	..	...	..	..	..
lysitensis	..	..	...	20	32	96	3	17	..
minor	..	..	...	..	1	2	..	..	..
wortmani	..	..	...	..	..	...	2	14	..
mentalis	..	..	...	5	1	...	..	50	27
browni	..	..	...	..	92	2	1	..	..
powellianus	..	..	...	..	4	114	..	..	..
walcottianus	..	..	...	..	..	...	2	3	..
(Total)	18	24	451	26	130	214	8	84	27

The Status of the genus Diacodexis Cope 1882.[1]

(Type *Phenacodus laticuneus* Cope 1882.[2]) The type species of this genus was based upon a specimen, No. 4202, Am. Mus. Coll., consisting of three jaw fragments with teeth supposed to belong to one individual. It now appears that these three fragments pertained to animals of three different orders of mammalia, as follows:

(a) Upper premolars of *Eohippus* sp.

(b) Upper molars of *Hyopsodus* sp.

(c) Last lower molar of an Artiodactyl related to *Trigonolestes*.

When the Cope collection was acquired by the American Museum this type was reëxamined by Professor Osborn and Dr. Wortman, and recognized as a composite of *Eohippus* and *Hyopsodus*. As a result of this examination in 1899 the upper premolars were removed from the type by Matthew[3] and the species referred to *Hyopsodus*. The characters of the upper molars were the substantive basis of this reference, the lower molar being recognized as abnormal for *Hyopsodus* although its true character was not suspected. The new collections from the Wasatch beds of the

[1] Amer. Nat., Vol. XVI, p. 1029.
[2] Proc. Am. Phil. Soc., Vol. XX, pp. 179, 181.
[3] Bull. A. M. N. H., Vol. XII, p. 30.

Bighorn Valley include remains of a number of genera and species of Trigonolestidæ, comparison of which with the lower molar of *Diacodexis* enabled Mr. Granger to recognize its real relationship.

The upper molars are unquestionably *Hyopsodus* and agree with specimens referred to *H. powellianus* Cope 1885. (*P. zuniensis* Cope,[1] 1882, *l. c.*)

Of the three specimens, No. 4202, a., b. and c. which constitute co-types of *Diacodexis laticuneus,* the jaw fragment with m_3 must apparently be taken as lectotype. It is the first described specimen, as its characters form the basis of the specific distinctions given in the key to the species of *Phenacodus* on p. 12 and a reference to this characterization precedes the description of the upper molars in the species description on p. 19. It is the specimen upon which the species name is obviously based. And it is a corresponding part to the type specimen of *P. primævus* which Cope had described in 1873, on the evidence of a last lower molar. The m_3 of "*Phenacodus*" *laticuneus* agrees sufficiently with the type m_3 of *P. primævus* to suggest its belonging to the same genus; this suggestion was evidently confirmed in Professor Cope's mind by comparison of the upper molars, No. 4202b, with those of other species of *Phenacodus, P. primævus* and *P.* (now *Tetraclænodon*) *puercensis.*

The lower jaw fragment therefore was the primary basis of the specific distinctions and in part the basis of the generic reference of the original description of *P. laticuneus,* and is the first of the cotype specimens to be described. Following the intent of the author so far as ascertainable[2] it should therefore be selected as the lectotype.

Diacodexis thus stands as a genus of Eocene Artiodactyla, not as a synonym of *Hyopsodus,* and the name has been so used by Dr. Sinclair,[3] preoccupying *Trigonolestes* of later date.

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[1] This is not *P. zuniensis* Cope 1881 (Proc. Am. Phil. Soc., XIX, 492), which was referred by Matthew in 1897 to *Tricentes subtrigonus.*

[2] See Catalogue of Type Specimens U. S. National Museum, Introduction, p. 12.

[3] Sinclair 1914, Bull. A. M. N. H., Vol. XXXIII, p. 289.

56.9c(1181:78.7)

Article X.— A REVISION OF THE LOWER EOCENE WASATCH AND WIND RIVER FAUNAS.

By W. D. Matthew and Walter Granger.

PART III.— ORDER CONDYLARTHRA.

Families PHENACODONTIDÆ and MENISCOTHERIIDÆ.

By Walter Granger.

Family PHENACODONTIDÆ *Cope*, 1881.

Four genera have been commonly placed in this family, *Protogonodon* and *Tetraclænodon* from the Puerco and Torrejon formations, respectively, of the Basal Eocene, and *Phenacodus* and *Ectocion* from the various horizons of the Lower Eocene. Of the genus *Protogonodon* from the Puerco the writer feels that it should be removed from the family, the chief reasons being the lack of anything like a well developed hypocone on the upper molars and the basining of the lower molars. Earl has suggested [1] its affinities with the ancestral Artiodactyl stem and while the lower molars do resemble very much those of the Bunodont Artiodactyla of the Lower Eocene, yet the premolars are already showing a tendency toward complication as evidenced by the presence of an incipient metaconid on p_4. It seems more probable that *Protogonodon* is a Creodont belonging to either the Oxyclænidæ or Arctocyonidæ.

If *Protogonodon* be removed from the family, the tooth characters may be defined as follows:

Dental characters of the Phenacodontidæ. First and second upper molars quadrate and consisting of four principal cusps and two intermediates, no marked tendency toward the formation of a metaloph but the conules often uniting with the protocone to form a V; third upper molar always somewhat reduced and differing in outline from the other two molars because of the reduction of the metacone, the hypocone, or both; first and second lower molars composed of four principal cusps, subequal in size, and a prominent

[1] Amer. Nat., 1893, p. 377.

hypoconulid, and usually with small accessory cusps on both the anterior and posterior slopes of the metaconid and on the anterior face of the entoconid; hypoconid and metaconid separated by a valley; last lower molar similar to anterior ones but with the hypoconulid enlarged and produced into a short heel, the tooth being usually the longest and always the narrowest of the lower molars; posterior upper and lower premolars with a strong tendency to become molariform; first lower premolar single-rooted; first

Fig. 1. Outlines of upper cheek-teeth of the three genera of Phenacodontidæ.

upper premolar two-rooted in some forms; canine of moderate size; incisors broad, chisel-edged.

Occurrence. *Tetraclænodon* is confined to the Torrejon[1] where it is the most abundant form, specimens of the genus constituting about one-fifth of the entire collection from this horizon. *Phenacodus* and *Ectocion* range together throughout the Lower Eocene, from the Clark Fork to the Lost

[1] A closely related, possibly identical, genus is found in the Fort Union beds in Montana.

Cabin. In the Clark Fork beds the family predominated to a still greater extent than in the Torrejon, at least three-fourths of the specimens obtained from this horizon being of this family and the collecting was done at various levels and over a considerable areal range. *Phenacodus* is fairly common in the Clark Fork, most abundant in the Gray Bull and fairly common again in the Lysite and Lost Cabin. *Ectocion* is most abundant in the Clark Fork,

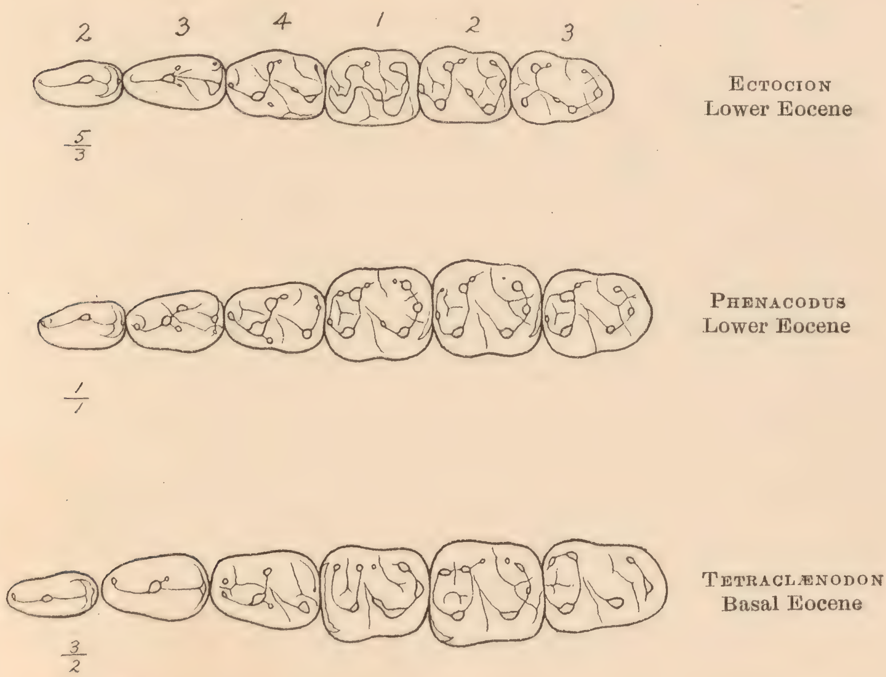

Fig. 2. Outlines of lower cheek-teeth of the three genera of Phenacodontidæ.

common in the Gray Bull, absent from the Lysite and rare in the Lost Cabin. In the New Mexico horizons *Ectocion* is absent while *Phenacodus* is rather uncommon in the lower and rare in the upper level.

Key to Genera of Phenacodontidæ.

A. Mesostyle rudimentary or absent . . . . *Tetraclænodon.*

B. Mesostyle well developed

  b. Teeth bunodont, mesostyle and metacone weak on m^3, p_4 with entoconid weak or absent, p_3 with low posterior basal cusp. M^1 and m^2 with metaconule on a line between metacone and hypocone or posterior to it. *Phenacodus.*

  bb. Teeth more or less lophodont, mesostyle and metacone well developed on m^3; p_4 with strong entoconid, p_3 with high compressed posterior basal cusp; m^1 and m^2 with metaconule anterior to a line between metacone and hypocone . . . . *Ectocion.*

Tetraclænodon *Scott*, 1892.[1]

Protogonia Cope, 1881 (preoccupied).
Euprotogonia Cope, 1893.

Type, *Mioclænus floverianus* Cope, from the Torrejon formation of New Mexico.

In some respects, particularly in the forward position of metaconules and the semi-isolation of the hypocone, this genus shows rather closer relationships with *Ectocion* than with *Phenacodus.* In the absence of any skeleton material of *Ectocion,* beyond an astragalus and a few fragments, it is, however, not possible to make very satisfactory comparisons.

In his Revision of the Puerco Fauna,[2] Dr. Matthew recognized two species of the genus, *T. puercensis,* the common form, and *T. minor,* a diminutive species represented by only three specimens. There is a wide range among the specimens referred to *T. puercensis,* not only in size but in minor details of cusp development. This variation is found in *Phenacodus* also, and with a large series of specimens, over 300 of *Tetraclænodon,* it is very difficult to select a set of specific characters which works out satisfactorily. It is now known that *Tetraclænodon* comes from two distinct horizons in the Torrejon and a study of the new material of this genus, in which the level of each specimen is known, may yield some definite systematic results.

Phenacodus *Cope,* 1873.[3]

Opisthotomus Cope, 1875.
"*Trispondylus*" Cope, 1884.
?*Eohyus* Marsh, 1894 (genotype only).

Type, *P. primævus* Cope, from the Wasatch[4] of Evanston, Wyo.

There are now in the American Museum Collection several hundred specimens of this genus, representing all of the Lower Eocene horizons of Wyoming and New Mexico. Together they present a bewildering array with their great variation in size and in the lesser characters of the teeth which in many groups would constitute good specific differences but which here often appear to be only individual. The difficulty is increased by the fact that the group shows little or no evolution throughout its range. The last survivors in the Lost Cabin beds cannot be separated specifically from

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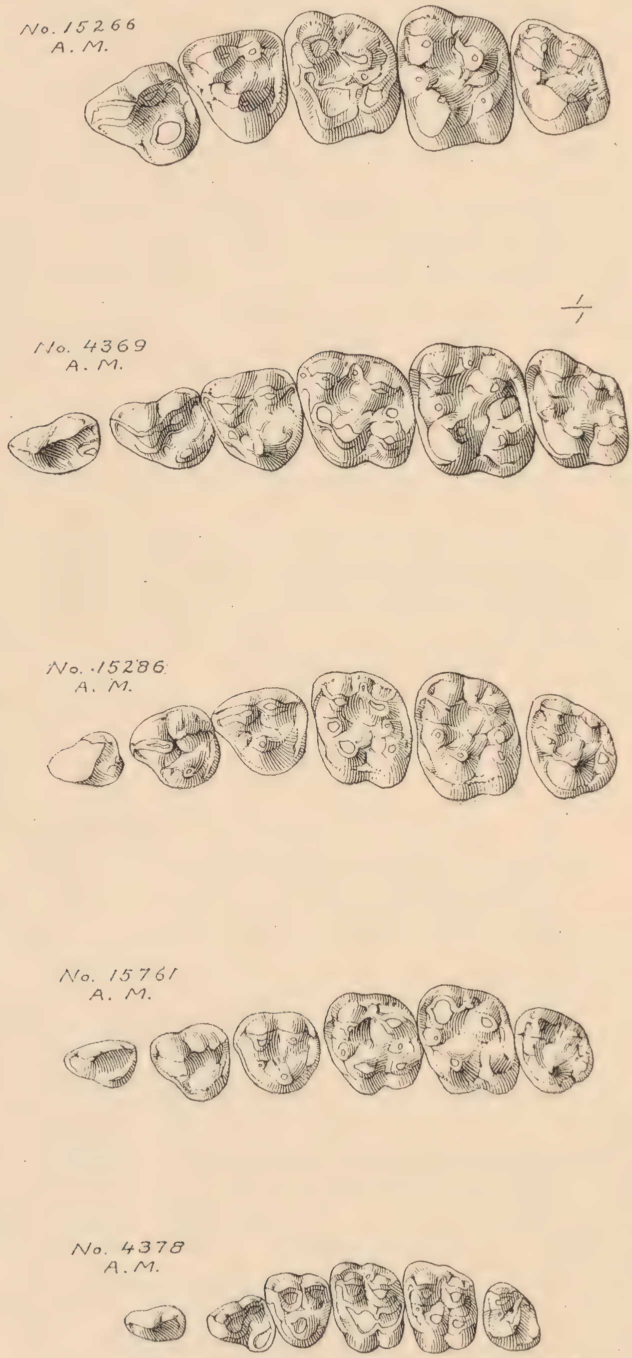
[1] Proc. Acad. Nat. Sci. Phila., 1892, p. 299.
[2] Bull. A. M. N. H., 1897, p. 303.
[3] Palæont. Bull., No. 17, p. 3.
[4] Knight formation of Veatch.

Measurement Key to Species of Phenacodus.

(Measurements in millimeters.)

	p^3–m^3	m^{1-3}	m^2 ant-post. diam.	m^2 tr. diam.	m^3 ant. post. diam.	m^3 tr. diam.	p^4 ant-post. diam.	p^4 tr. diam.	p_3–m_3	m_{1-3}	m_2 ant-post. diam.	m_2 tr. diam.	m_3 ant-post. diam.	m_3 tr. diam.	p_4 ant-post. diam.	p_4 tr. diam.
P. primævus robustus subsp. nov. Type, No. 15275; Gray Bull beds, Bighorn basin, Wyo.	—	—	—	—	—	—	—	—	68.5	43.	13.7	13.	14.	11.3	13.6	9.6
P. ——— ———. Paratype, No. 15266; Gray Bull beds, Bighorn basin, Wyo.	57.5	36.7	12.7	16.7	10.3	10.5	11.	13.	—	—	—	—	—	—	—	—
P. primævus Cope. Plesiotype, No. 4369; Gray Bull beds, Bighorn basin, Wyo.	59.5	36.3	12.8	14.8	10.5	14.	11.2	11.3	67.5	41.2	13.7	12.	13.7	10.7	13.7	9.
P. primævus hemiconus Cope. Topotype, No. 15286; Gray Bull beds, Bighorn basin, Wyo.	51.5	32.5	11.	14.5	9.7	12.2	—	—	59.5	36.5	12.	11.	12.2	9.2	10.7	—
P. intermedius sp. nov. Type, No. 15761; Gray Bull beds, Bighorn basin, Wyo.	47.5	29.5	10.5	12.2	8.	10.	9.	9.5	54.	32.5	11.5	10.5	10.5	8.5	10.5	7.
P. copei sp. nov. Type No. 4378; Gray Bull beds, Bighorn basin, Wyo.	37.	23.	8.3	11.	6.	8.	7.3	8.2	45.	28.	9.5	7.5	9.7	6.7	8.8	8.
P. vortmani Cope. Topotype, No. 2983; Lost Cabin beds, Wind River basin, Wyo.	36.5	21.5	8.	10.	6.5	8. (est.)	7.5	8.	41.5	25.	8.	7.	9.	6.5	8.	5.5
P. brachypternus Cope. Topotype, No. 15315; Gray Bull beds, Bighorn basin, Wyo.	30. (est.)	17.2	6.	8.5	4.5	7.	6.	7.2	33.5	19.2	6.2	5.3	6.2	4.1	7.2	4.4

those forms of the same size in the Clark Fork, where the genus makes its first appearance. There are obviously several species, indicated by size



P. primævus robustus
(Paratype, Gray Bull beds, Bighorn basin, Wyo).

P. primævus
(Plesiotype, Cope skeleton, Gray Bull beds, Bighorn basin, Wyo.)

P. primævus hemiconus
(Topotype, Gray Bull beds, Bighorn basin, Wyo.),

P. intermedius
(Type, Gray Bull beds, Bighorn basin, Wyo.)

P. copei
(Type, Cope skeleton, Gray Bull beds, Bighorn basin, Wyo.)

Fig. 3. Upper teeth of species of *Phenacodus.*

and the relative proportions of the teeth, and in one or two cases by premolar characters of rather doubtful constancy. An effort has been made to hold as many of the old names and to create as few new ones as possible.

Phenacodus primævus *Cope,* 1873.

Palæont. Bull., No. 17, 1873, p. 3; 1885, Tert. Vert., p. 435, pll. lviib-lviii.
Syn. *P. omnivorus* Cope, 1874.
P. trilobatus Cope, 1881.
P. nunienus Cope, 1885 (in part).

Type of species and genus, Amer. Mus. Cope Coll. No. 4408, a somewhat worn and weathered last lower molar, from the Knight formation [1] of the Wasatch group, on Bear River, near Evanston, Wyo.

So far as I am aware no other specimens of the genus, than the one

P. vortmani
(Topotype, Lost Cabin beds, Wind River basin, Wyo.)

P. brachypternus
(Topotype, Gray Bull beds, Bighorn, basin, Wyo.)

Fig. 4. Upper teeth of species of *Phenacodus.*

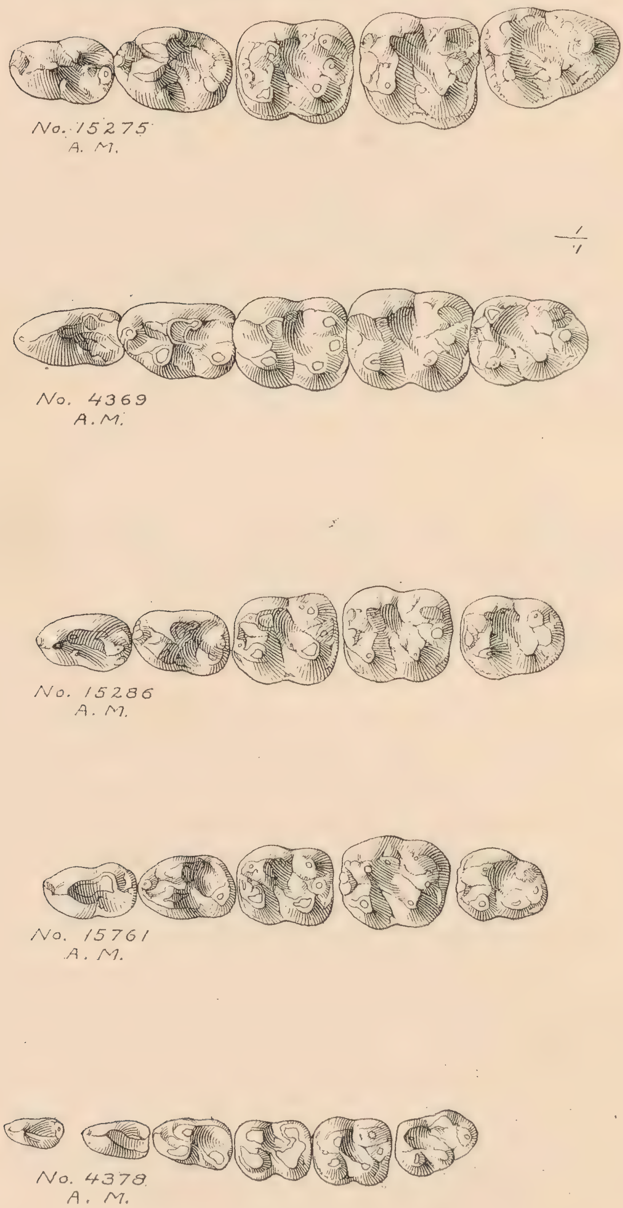
recorded above, have ever been found in the type locality, and for purposes of comparison it has been necessary to select one of Cope's supplementary types from another region. The splendid skeleton from the Bighorn basin, identified by Cope and very thoroughly described and figured in the Tertiary Vertebrata, offers a most satisfactory plesiotype. The skeleton is from a horizon, the Gray Bull, which is probably a stage lower than the Knight beds but there is almost perfect agreement between the type and the corresponding tooth of the plesiotype, so that, in the absence of more complete material from the type locality, the Bighorn basin skeleton must be considered as identical with the type. In the extensive collection of Phenacodonts, a form may be seen to run through several faunal stages without alteration in specific characters.

P. primævus is the largest and commonest of the species of *Phenacodus.*

[1] See Veatch, 1907, U. S. G. S., Prof. Paper No. 56, p. 92.

Its relative abundance in the different horizons of the Bighorn and Wind River basins is shown in the list of specimens in the Museum collection.

Lost Cabin	2	specimens
Lysite	0	"
Gray Bull	225	"
Sand Coulée	3	"
Clark Fork	35	"



P. primævus robustus (Type, Gray Bull beds, Bighorn basin, Wyo.)

P. primævus (Plesiotype, Cope skeleton, Gray Bull beds, Bighorn basin, Wyo.)

P. primævus hemiconus (Topotype, Gray Bull beds, Bighorn basin, Wyo.)

P. intermedius (Type, Gray Bull beds, Bighorn basin, Wyo.)

P. copei (Type, Cope skeleton, Gray Bull beds, Bighorn basin, Wyo.)

Fig. 5. Lower teeth, crown views, of species of *Phenacodus*.

For the most part the specimens are jaws or jaw fragments, but there are a few crushed or distorted skulls and in three instances an approach toward a skeleton.

The dental structure and osteology of the species has been thoroughly described and figured and there is but little to add. Comparatively few of the referred specimens show as long a p_4 as the plesiotype, or as large a hypocone on the m^3, but there are minute gradations between the extremes in these characters and they appear to be only individual, as are the differences in the prominence of the various accessory cusps on both molars and premolars and the relative size of the last upper and lower molars.

One of the two specimens from the Lost Cabin, a maxilla (No. 14786) from Alkali Creek, Wind River basin, agrees almost exactly, except for a swelling of the mesostyles, with a similar specimen (No. 16058) from the

P. vortmani
(Topotype, Lost Cabin beds, Wind River basin, Wyo.)

P. brachypternus
(Topotype, Gray Bull beds, Bighorn basin, Wyo.)

Fig. 6. Lower teeth, crown views, of species of *Phenacodus*.

Clark Fork beds, and both of these are inseparable from the plesiotype from the Gray Bull beds.

Phenacodus nunienus.[1] Under this name Cope described some limb bones which he considered as belonging to the largest species of the genus and which possessed anatomical characters distinct from *P. primævus.* He chose for his descriptions, measurements and figures a humerus and the lower end of a scapula which were found associated with jaws and fragmentary skeleton material belonging to two or more individuals of *P. primævus,* and a skull, jaws and part of skeleton of *Pachyæna ossifraga.* The humerus certainly belongs to the *Pachyæna* specimen and probably also the fragment of scapula. Queerly enough Cope identified and figured [2] as the humerus of *Pachyæna* a bone which undoubtedly belongs to one of the *Phenacodus* skeletons.

Phenacodus omnivorus [3] was described by Cope from a last upper molar from the Wasatch of New Mexico, collected in 1874 (Nat. Mus. Coll. No.

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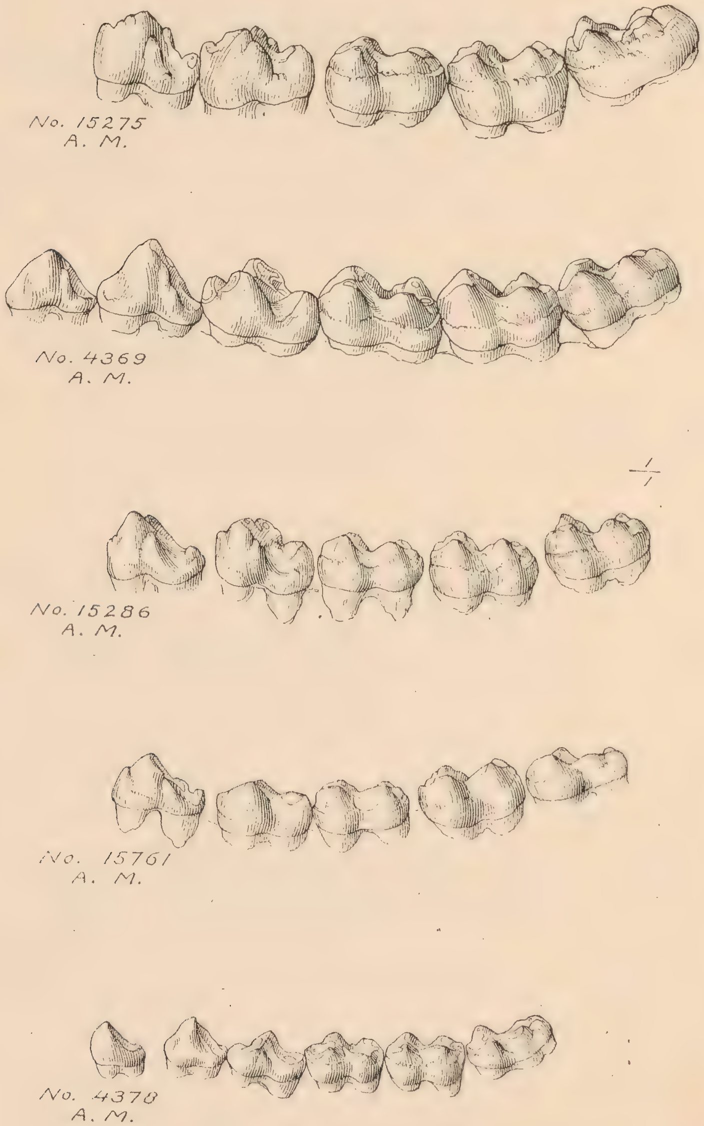
[1] Tertiary Vertebrata, 1885, p. 434, pl. lviig, figs. 7, 8.
[2] Tertiary Vertebrata, 1885, p. 366, pl. xxiiic, fig. 1.
[3] Rep. Foss. Vert. N. Mex., 1874, p. 11,

5382), and which Cope later doubtfully but correctly referred to his *P. primævus.* In a specimen of upper teeth from the same beds, which Cope referred to *P. primævus,* he mistook the second molar for the last, and of course the differences between this tooth and the type of *P. omnivorus* were obvious.

Phenacodus trilobatus Cope[1] was established on a jaw fragment with



P. primævus robustus (Type, Gray Bull beds, Bighorn basin, Wyo.)

P. primævus (Plesiotype, Cope skeleton, Gray Bull beds, Bighorn basin, Wyo.)

P. primævus hemiconus (Topotype, Gray Bull beds, Bighorn basin, Wyo.)

P. intermedius (Type, Gray Bull beds, Bighorn basin, Wyo.)

P. copei (Type, Gray Bull beds, Bighorn basin, Wyo.)

Fig. 7. Lower teeth, external views, of species of *Phenacodus.*

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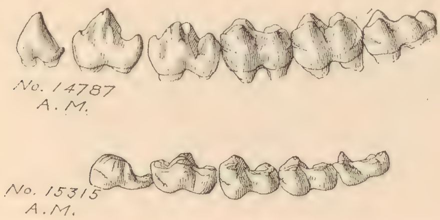
[1] Bull. U. S. Geol. and Geogr. Surv., 1881, p. 200.

the three molars (No. 4679), from the Wasatch of the Bighorn basin. Cope differentiated it from *P. primævus* by the presence of accessory cusps on the anterior and posterior slopes of metaconid. In his Tertiary Vertebrata Cope recognized that these characters were merely individual variations.

There is, among the specimens which I have referred to *P. primævus*, a considerable variation in size, relative width, and general robustness of the teeth. And since the specimens showing these variations fall into



P. vortmani
(Topotype, Lost Cabin beds, Wind River basin, Wyo.)

P. brachypternus
(Topotype, Gray Bull beds, Bighorn basin, Wyo.)

Fig. 8. Lower teeth, external view, of species of *Phenacodus*.

rather well defined groups, it seems well to consider these groups as of subspecific rank, one group being smaller than the plesiotype, the other larger.

Phenacodus primævus hemiconus *Cope*, 1882.

Phenacodus hemiconus, Proc. Am. Phil. Soc., 1882, p. 179; 1885, Tert. Vert., p. 463, pl. xxve, fig. 16.

Type, Amer. Mus. Cope Coll. No. 4391, a fragment of the upper jaw with the second and third unworn molars; ?Gray Bull beds, Bighorn basin, Wyo., J. L. Wortman, 1881.

The chief distinctions from *P. primævus* pointed out by Cope were the smaller size and the rudimental character of the hypocone and metacone in m^3. The size of the cusps on this tooth is variable within specific limits and while the individual is somewhat smaller than the type of *P. primævus* yet it seems that it is hardly sufficient to keep it separate as a distinct species. Eleven specimens from the Gray Bull beds and one from the Lost Cabin are referable to this small variety. Of these I select for illustration a topotype consisting of a palate and lower jaws (No. 15286), from the Gray Bull beds, with the third premolar to third molar, above and below, well preserved (Figs. 3, 5, 7). The agreement in size and structural characters with Cope's type are very close.

Phenacodus primævus robustus subsp. nov.

Type, No. 15275, a left ramus with p_3–m_3 in unworn condition; Gray Bull beds, Bighorn basin, Wyo., Exp. 1910.

Six specimens of *P. primævus* from the Gray Bull have teeth of about the same anteroposterior dimensions as the plesiotype but with greater transverse diameters, giving the teeth a much more robust appearance.

One specimen (No. 15266) shows upper molars and fourth premolar (Fig. 3). Another (No. 4370) has upper and lower jaws, femur, tibia, and lower end of scapula. The limb bones, while not much longer than those of the skeleton of *P. primævus,* are much more massive, the comparative widths across the femoral condyles being 58 and 66 mm. They indicate an animal perhaps two or three inches taller and of at least twice the weight.

Phenacodus intermedius sp. nov.

Type, No. 15761, upper and lower jaws; Gray Bull beds, Five Mile Creek, Bighorn basin, Wyo. Exp. 1911.

About twenty-five specimens from the Gray Bull beds represent a form somewhat smaller than the type of *P. hemiconus* from the same beds and locality. This group seems too small to include in the species *P. primævus.* Comparing the type with the type and topotype of *P. hemiconus,* which form approaches it most nearly in size, there is a greater reduction of the m^3 and a relatively larger p^4 than in *P. hemiconus.* The intermediate cusps of the molars are also less distinct; on m^2 the metaconule is entirely absent. In p_3 the metaconid is placed lower than in *P. hemiconus.*

Paratype, No. 15777, a maxilla supporting all teeth from canine to m^3, unworn; Gray Bull beds, Shoshone River, Bighorn basin, Wyo. Exp. 1911.

This beautifully preserved specimen (Fig. 9) affords a good supplementary type, since it presents three anterior teeth not preserved in the holotype. The posterior half of the third molar is missing, but otherwise the teeth are perfect. The specimen agrees very closely with the type, except that the metaconule is absent from m^1 instead of m^2. The canine is large, relatively about the same size as in *P. primævus;* p^1 is shaped like the canine and half the size, p^2 shows a broad outer cusp and posterior internal ledge. There is just a suggestion of two or three cusps on the posterior ridge of the protocone. P^3 presents 5 cusps in line on the outer face; the large protocone, a lower cusp, the tritocone, posterior to the protocone, and a still lower accessory cusp posterior to the tritocone, while at the posterior and anterior angles of the tooth are tiny cusps produced on the cingulum. The strong conical deuterocone is placed posteriorly, opposite the tritocone, instead of between the protocone and the tritocone as in p^4. An elevated tip of the cingulum occupies the position of the protoconule in p^3; p^4 has the protocone slightly larger than the tritocone and there is a strong protoconule. The p^1 is placed close behind the canine. There is a considerable diastema between p^1 and p^2 and a shorter one between p^2 and p^3.

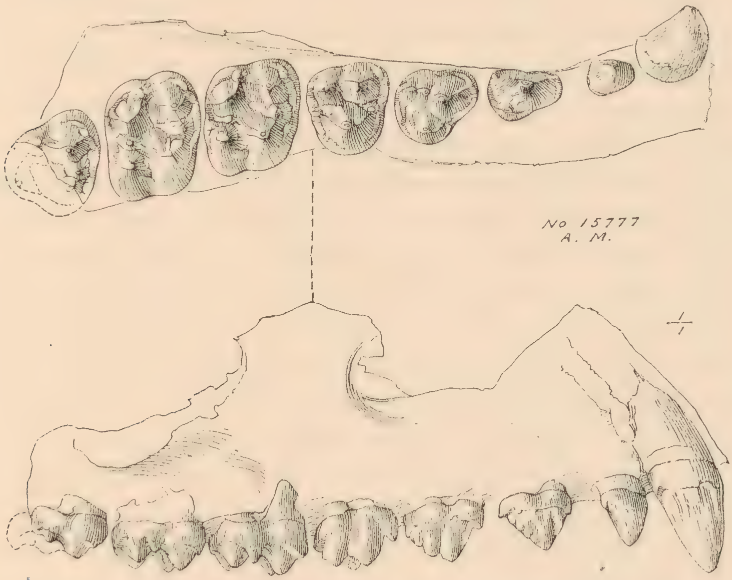


Fig. 9. *Phenacodus intermedius*, crown and external views of unworn maxillary teeth. Paratype, Gray Bull beds, Bighorn basin, Wyoming.

Measurements of paratype, No. 15777.

		mm.	
c–m³		73.	(approx.)
c	ant. post. diam. at base	7.8	
c	tr. " " "	6.2	
c	length, from base of enamel, outside	12.7	
p¹	long. diam.	5.	
p¹	length, from base of enamel, outside	6.3	
p²	long. diam.	8.	
p²	tr. "	5.6	

Two badly flattened skulls (Nos 15268 and 15765) have teeth agreeing closely with the type in size and the reduction of metaconules on m^2, but the skull, as nearly as can be judged in this crushed condition, does not show a corresponding reduction in length for *P. primævus*. The better preserved one seems to have been nearly as long in the temporal region as *P. primævus* but more slenderly built. A pair of lower jaws (No. 15764) shows an extreme length of approximately 160 mm. as compared with 195 mm. in *P. primævus.*

From the Clark Fork beds are several fragmentary specimens which seem to fall into this group. From the Sand Coulee beds are lower jaw fragments, and from the Lost Cabin some ten or twelve fragmentary specimens are doubtfully referred to this species. Most of these agree in size and in the reduction or absence of metaconules. In Nos. 14794 and 14796 this cusp is absent from both the first and second molars.

Two of these Lost Cabin specimens (Nos. 14784 and 14797) appear to represent either a well marked variety of *P. intermedius* or, more likely, a distinct species. The first specimen consists of jaw fragments with p_2–m_1; the second specimen of a first or second lower molar and a p^4, with which are associated fragmentary limb bones, a calcaneum and astragalus, and parts of both fore feet, one nearly complete. Both of these specimens show a much greater reduction of the premolars than is observed in any specimen of *P. intermedius* from the Gray Bull beds. In No. 14797 the p^4 has the same transverse diameter as the p^4 of the type, but is a much narrower tooth, antero-posteriorly, which coincides with the antero-posterior reduction of the lower premolars of No. 14784.

There is no foot or limb material of *P. intermedius* from the Gray Bull beds for comparison with the Lost Cabin specimen. Compared with the fore foot of *P. primævus* it shows a trifle more slender Mc I but otherwise no differences except in size.

Measurements.

	No. 14797	*P. primævus*
Mc. III	52.5	72.
Mc. V	28.	36.
Mc. I	23.	28. (est.)

The difference in size of the feet is greater than one would expect to find between *P. primævus* and the type of *P. intermedius.* I hesitate to separate these Lost Cabin specimens, because of the lack of comparative material, and because the individual variations in this genus are so great.

From the Sand Coulee beds a specimen consisting of upper and lower jaws (No. 16131) shows in the lower teeth the same reduction of the premolars, but not of p^4.

From the lower horizon of New Mexico a lower jaw (No. 16246) is intermediate in size between *P. intermedius* and *P. hemiconus.*

Phenacodus vortmani *Cope*, 1880.

Cope, 1880, Amer. Nat., p. 747 (*Hyracotherium*); 1885, Tert. Vert. p. 433, pl. lviii, fig. 9.
Syn. *?Phenacodus apternus* Cope, 1882.

Type, Amer. Mus. Cope Coll. No. 4824, a left ramus with the p_4 and a damaged m_1 and the roots of other molars and premolars; Lost Cabin beds, Alkali Creek, Wind River basin, Wyo., J. L. Wortman, 1880.

A very satisfactory topotype is represented by No. 14787, lower jaws with all molars and premolars, unworn, and No. 2983, a maxilla with p^3–m^3, unworn (Figs. 4, 6 and 8). The lower jaws were collected in 1909, the maxilla in 1896, both are recorded as coming from the north side of Alkali Creek near its mouth and both are from the same distinctive matrix, a light gray clayey sandstone, in which fossils are rare. The lower teeth fit exactly to the uppers and both show the same slight traces of wear on the first and second molars. It is without much hesitation that I consider them as belonging to one individual.

Distinctive characters, as shown by the topotype, are, aside from the measurements of the teeth, ramus relatively short and deep; p_3 with a well defined anterior basal cusp, fairly well defined external and internal cusps of equal size on the posterior face of the protoconid and an unusually high posterior basal cusp; p_4 without entoconid but with the posterior inner angle developed into a low ridge, forming a shallow basin; p^4 with outer cusps of nearly equal size, inner cusp bent slightly forward and with the cingulum on the posterior side of the tooth developed into a point, which foreshadows the tetartocone; p^3 with large and small outer cusps and large inner cusp, twisted forward away from p^4 and opposite the cleft between the outer cusps.

Occurrence. About 15 specimens from the Lost Cabin are referable to this species, chiefly by size alone since most of the specimens consist of molar teeth only. From the Lysite three specimens agree in size. From the Gray Bull beds five, and one from the lower horizon of New Mexico is doubtfully referred. The reference of all specimens not from the type-horizon, however, is only provisional.

Phenacodus apternus Cope, 1882,[1] from the Gray Bull beds of the Bighorn basin, is based on three fragments of lower jaws, each supporting the three true molars. The species was based principally upon the "oval form of the last inferior molar," a character in which the three cotypes differ as

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[1] Palæont. Bull., No. 34, p. 180.

much among themselves as they do from the topotype of *P. vortmani* from which species I cannot distinguish them. The measurements of the molar series are: No. 4390 = 25.7, 4392 = 25. , and 4393 = 25.7 mm., as compared with 25 mm. in the topotype of *P. vortmani.*

Phenacodus copei sp. nov.

Phenacodus vortmani Cope, Tert. Vert. 1885, p. 464, pll. xxix e, xxix f, lvii h, fig. 17 (not *P. vortmani* Cope, 1881); "*Trispondylus*" *vortmani*, 1884, Am. Nat. (foot-note) p. 900 (not *P. vortmani* Cope, 1881).

Type, Amer. Mus. Cope Coll. No. 4378, a nearly complete skeleton; Gray Bull beds, Bighorn basin, Wyo. J. L. Wortman, 1881.

The discovery of excellent supplementary material of *P. vortmani* in the Lost Cabin beds serves to bring out differences between that species and the Gray Bull skeleton which Cope referred to *P. vortmani.* The differences are of specific value, and the distinguishing characters are: p_3–m_3 = 45 mm., m_1–m_3 = 28 mm., p^3–m^3 = 37, m^{1-3} = 23; metaconules reduced or absent; p^3 with tritocone very small, deuterocone with a posterior position, opposite the tritocone; p_3 without anterior basal cusp and with low posterior basal cusp; teeth more robust than in *P. vortmani.*

In the type of *P. copei* the last lower molar is not reduced while the last upper molar is very much so. In a referred specimen (No. 15333) the lower molar is the same as in the type but the upper molar is not much reduced. The relative size of this tooth appears to be of little value as a specific character in this genus.

Occurrence. Eleven specimens, chiefly lower jaw fragments, from the Gray Bull beds are referred to this species. From the Lysite there are twenty-five specimens, mostly very fragmentary, and of these only two are from the typical Lysite, the balance being from Buffalo basin where this species is the only one of the genus represented. From the lower horizon of New Mexico two specimens are referable.

From the Sand Coulee beds a single specimen (No. 16125) shows in the third upper premolar the characters of *P. copei* and in the lower those of *P. vortmani,* with which it also agrees in size of teeth.

Phenacodus brachypternus *Cope,* 1882.

Palæont. Bull., No. 34, 1882, p. 180; 1885, Tert. Vert., p. 433, pl. xxv e, fig. 14.

Type, Amer. Mus. Cope Coll. No. 4396, a left ramus with p_3-m_3; Gray Bull beds, Bighorn basin, Wyo. J. L. Wortman, 1881.

Distinctive Characters. P_3–m_3 = 33 mm., m_{1-3} = 20 mm.; p_4 elongate and narrow with very prominent paraconid, longer and narrower than any of the molars; p_3 with broad low heel and a small accessory cusp high up on anterior ridge of protoconid; ramus rather slender; weak metaconules on m^2.

Cope founded this species on "three mandibular rami — all displaying the fourth premolar" without specifying a type, but the measurements, most of his characters and the figures were drawn from No. 4396, which is much the most complete and which it seems proper to consider as the type, especially since neither of the other fragments furnishes any characters not found in this one. This is the smallest species of the genus and in some respects the most primitive. The long compressed p_4 and the simple compressed p_3 serve to distinguish it from *P. vortmani,* the next largest species. Most of the specimens show on the fourth premolar a high trenchant hypoconid development and a steep slope down to the inner side of the tooth without much trace of entoconid development. In most of the specimens there is a small accessory cusp in front of and between the protoconid and metaconid on the p_4. The last upper molar is much reduced in the four specimens in which this tooth is present, while the last lower molar varies from a slight to a marked reduction. In one specimen of badly worn upper and lower teeth (No. 15331) the p^3 is elongate with the inner cusp placed at the extreme postero-internal angle, opposite the posterior outer cusp. It is in the character of this tooth and of the lower premolars that this species is the most primitive of the genus.

Occurrence. Twenty specimens from the Gray Bull beds of the Bighorn basin, and two from the lower horizon of New Mexico are identifiable with this species. Its occurrence in the other horizons has not been noted.

From the upper beds of New Mexico, near Ojo San Jose, is a finely preserved maxilla (Fig. 10) with the canine and all cheek teeth (No. 16249). It is slightly larger than the type of *P. brachypternus* and differs in having the m^3 but slightly reduced and with well developed metacone and mesostyle; p^4 is unusually broad antero-posteriorly and shows a metaconule. The third premolar is elongate and primitive in construction; p^2 is slightly expanded posteriorly and with a small cusp at the postero-external angle; p^1 is double-rooted, a condition not observed in the ten other specimens of *Phenacodus* in which this part

Fig. 10. *Phenacodus (?) brachypternus,* upper teeth, crown view. Largo beds, San Juan basin, New Mexico.

of the maxilla is preserved, but it is a character of *Ectocion,* as also is the development of metacone and mesostyle on m^3, but the p^3 and the m^1 and m^2 are decidedly *Phenacodus* and not *Ectocion.* I hesitate to establish a new species for this single specimen, especially since no identifiable specimen of *P. brachypternus* showing the anterior premolars is present for comparison and the relative size of the m^3 is too variable in this genus, although it appears to be more constant in this species than in others. It is very possible also that the two-rooted condition of the p^1 is not an unvarying character within specific limits.

Measurements of No. 16249.

	mm.
c–m_3	51.
m^2 transverse diameter	9.5
m^2 antero-posterior diameter	7.
m^3 " "	6.
m^3 transverse "	8.2
p^3–m^3	35.
p^3 antero-posterior "	7.
p^3 transverse "	5.5

Phenacodus astutus (*Cope*), 1875.

Opisthotomus astutus Cope, 1875, System. Cat. Vert. Eoc. N. Mex., p. 16; *O. astutus* 1877, Ext. Vert. N. Mex., p. 152, pl. xlv, fig. 9.

Type, a first or second lower molar associated with a premolar tooth; from the Wasatch of New Mexico. E. D. Cope, 1874. Type lost.

The molar is, without question, that of a small species of *Phenacodus* but the premolar, which was mistaken by Cope for a last lower molar, and which formed the principal characters of the genus *Opisthotomus,* cannot be identified from the figure with any degree of satisfaction. The closest resemblance, shown in the inner view of the tooth, is to a fourth lower premolar of *Phenacodus* with reduced metaconid. The molar agrees in length, according to Cope's measurements, with the first or second molar of *P. brachypternus* but is slightly broader transversely. The premolar is of a size which might be associated with the molar but shows less wear than would be expected. Cope states that the two teeth were found in close association. Assuming that the association is correct and that no topotype can be selected, it seems best to let this species name stand for this specimen only rather than to refer other types and specimens to it, based on comparison with the molar tooth only.

The measurements of the teeth, as given by Cope, are as follows:

			mm.
Lower molar ($?m_1$) — antero-posterior diam.			6.5
"	" transverse	"	6.
"	premolar ($?p_4$) — antero-posterior	"	8.5
"	" transverse	"	5.

Incertæ sedis.

Opisthotomus flagrans Cope, 1875,[1] from the Wasatch of New Mexico, was described at the same time as *O. astutus.* The type, which is lost, is a lower jaw fragment with a single damaged tooth which Cope took to be the last molar. It is an unidentifiable type; the tooth as shown by Cope's figure has a considerable resemblance to the fourth milk molar of *Phenacodus primævus* but not close enough for certain identification.

Phenacodus sulcatus Cope, 1874,[2] from the Wasatch of New Mexico, was based upon a last upper molar of the left side (Nat. Mus. Coll. No. 1027). The tooth has the outline of a last molar of *Phenacodus* but differs in showing no trace of mesostyle and in having a metaloph developed as well as a protoloph, a character in which it resembles the Perissodactyla. The outlines of the tooth, however, together with the much reduced metacone and a rather indistinct hypocone, give the tooth an appearance very much unlike that of *Eohippus* or any other Lower Eocene Perissodactyl. The structure of the tooth and a certain peculiar irregularity or unevenness of the enamel surface leads me to think that this type is a malformed tooth of *Phenacodus.* It is about the size of *P. brachypternus,* the smallest species. Measurements are: anteroposterior diameter = 6. mm., transverse diameter = 8.1 mm.

Eohyus distans Marsh, 1894.[3] The type of this species and genus is a last upper molar of the left side (Yale Mus. Coll. No. 11889), from the "Coryphodon beds of New Mexico." As the name implies Marsh considered this an Artiodactyl with Suilline affinities. In the same paper he described a second species, *E. robustus,* from the "Lower Eocene of New Mexico," a type which Sinclair has correctly referred[4] to *Periptychus,* a Torrejon genus. Marsh's drawing of the type of *E. distans* is somewhat misleading. An examination of the specimen shows a facet for the m^2 which serves to orient the tooth, which gives it a different position in the jaw from that suggested by the drawing. The outline of the tooth is similar

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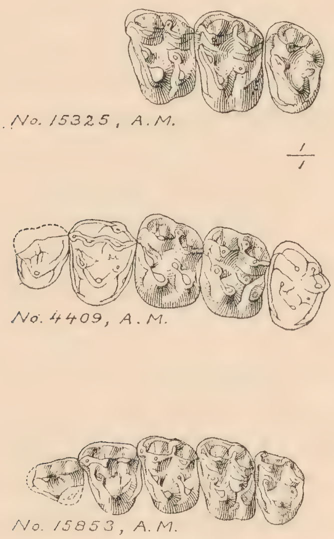
[1] System. Cat. Vert. Eoc. N. Mex., p. 16; Ext. Vert. N. Mex., p. 152, pl. xlv, fig. 8.
[2] Rep. Vert. Foss. N. Mex., p. 11; 1877, Ext. Vert. N. Mex., p. 179, pl. xlv, fig. 7.
[3] Am. Jour. Sci., Vol. XLVIII, p. 259, fig. 1.
[4] Bull. Am. Mus. 1914, p. 267.

to that of *Phenacodus* and unlike that of any other Wasatch form. The arrangement of the cusps also corresponds with *Phenacodus* in a general way, but the tooth differs in the enlargement of the protoconule and in the more swollen and rounded appearance of all the cusps. The protocone is the largest of the cusps and the metacone and hypocone are reduced and the metaconule and mesostyle are absent. The absence or extreme reduction of mesostyle and metaconule is, however, not rare in the m^3 of *Phenacodus*. I do not have much hesitancy in placing this type as a somewhat abnormal tooth of *Phenacodus*. In size it agrees most closely with the smaller variety of *P. primævus*. Measurements are: tr. = 11.2 mm., antero-post. = 10.2 mm.



E. (?) *superstes* (Gray Bull beds, Bighorn basin, Wyo.)

E. osbornianus (Type, Gray Bull beds, Bighorn basin, Wyo.)

E. ralstonensis (Paratype, Clark Fork beds, Clark Fork basin, Wyo.)

Fig. 11. Upper teeth of species of *Ectocion*.

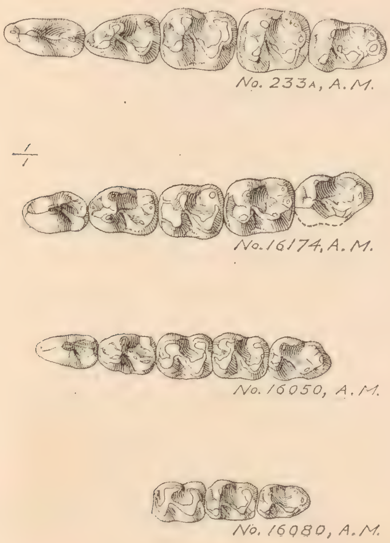
Ectocion *Cope*, 1882.[1]

Type. *Oligotomus osbornianus* Cope, 1882, from the Wasatch of the Bighorn basin, Wyo.

Cope based this genus upon a single poorly preserved specimen in his collection from the Wasatch of the Bighorn basin. In his Tertiary Vertebrata he placed the genus in the Chalicotheriidæ, but suspected its affinities with the Condylarthra to the extent of pointing out its difference from *Tetraclænodon* and *Phenacodus*. The forward position of the metaconule, similar to that in *Eohippus*, seems to have been the character which led Cope to consider *Ectocion* a Perissodactyl of a primitive sort, with the metaconule

[1] Amer. Nat., p. 522.

in the proper position for the development of the metaloph. There is, however, the important point that in the numerous specimens now available from several horizons no marked tendency toward the formation of a metaloph is shown. The metaconule is sometimes isolated, often connected with the protocone, and in some cases connected with both the protocone and hypocone forming with the protoconule two Vs, the posterior one opening toward the palate, the anterior one toward the center of the tooth. In only one specimen is the metaconule found connected with the hypocone and separated from the protocone by a deep valley as in Perissodactyla, and this individual happens to be from the lowest horizon of the genus and apparently represents merely an isolated example of deviation from the ordinary



E. superstes (Type, Lost Cabin beds, Wind River basin, Wyo.)

E. osbornianus (Topotype, Gray Bull beds, Bighorn basin, Wyo.)

E. ralstonensis (Type, Clark Fork beds, Clark Fork basin, Wyo.)

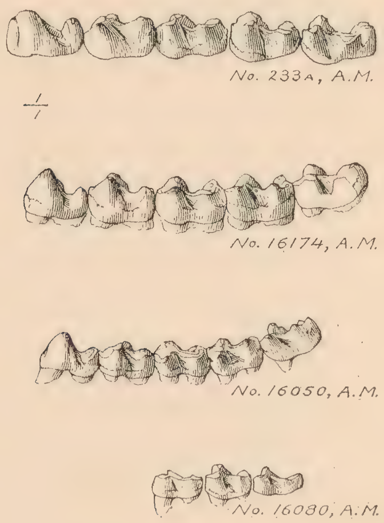
E. parvus (Type, Clark Fork beds, Clark Fork basin, Wyo.)

Fig. 12. Lower teeth, crown views, of the species of *Ectocion.*

condition, rather than any distinct phylum. The genus is of interest in this connection as presenting the type of upper molar from which the Perissodactyl molars might have been derived.

Additional Characters of Ectocion. Besides the characters given in the Key to Genera there are certain other features which separate this genus from *Phenacodus.* There is usually a metaconule on the p^4. The m^3 seldom has a hypocone and is a triangular tooth; in *Phenacodus* the hypocone is usually present, although smaller than the protocone. In *Ectocion* the hypoconulid of the lower molars is usually crowded inward toward the entoconid, while in *Phenacodus* this cusp is in the center of the tooth. In *Ectocion* there is a ridge descending anteriorly from the protoconid and passing across to the inner side of the tooth; in *Phenacodus* the ridge is joined in the center of the tooth by a ridge descending from the metaconid, thus forming a loop in front of the anterior pair of cusps.

Previous to the beginning of the Lower Eocene exploration in 1910 the collection contained but three specimens of the genus — the type, and one other fragment from the Gray Bull beds, and a lower jaw from the Lost Cabin. The collection now numbers over 150 specimens, chiefly jaw fragments and isolated teeth. The genus is confined to the Wyoming horizons. It is most abundant in the Clark Fork, very common in the Sand Coulee and the Gray Bull, absent from the Lysite and represented in the Lost Cabin by a single specimen. In its geological distribution it nearly parallels that of the large *Phenacodus*, *P. primævus*.



E. superstes
(Type, Lost Cabin beds, Wind River basin, Wyo.)

E. osbornianus
(Topotype, Gray Bull beds, Bighorn basin, Wyo.)

E. ralstonensis
(Type, Clark Fork beds, Clark Fork basin, Wyo.)

E. parvus
(Type, Clark Fork beds, Clark Fork basin, Wyo.)

Fig. 13. Lower teeth, external views, of the species of *Ectocion*.

A single specimen from the Sand Coulee beds has a few skeleton fragments in association, of these an astragalus is the most important. In general it is intermediate between *Tetraclænodon* and *Phenacodus*. It resembles *Tetraclænodon* in the long neck, in the narrow ectal facet and in having the sustentacular facet broad in the middle and tapering rapidly above and below, the outer line being angular instead of curved as in *Phenacodus*. The astragalus resembles *Phenacodus* in not being flattened and in having no astragalar foramen.[1] The lower end of a radius shows very small facets as in *Phenacodus*. In *Tetraclænodon* these are relatively larger.

The species of Ectocion present as difficult a problem as those of *Phena-*

[1] This foramen is usually absent in *Phenacodus* but not always.

Measurement Key to Species of Ectocion.

(Measurements in millimeters.)

	p^3–m^3	m^{1-3}	m^2 ant-post. diam.	m^2 tr. diam.	m^3 ant-post. diam.	m^3 tr. diam.	p^4 ant-post. diam.	p^4 tr. diam.	p_3–m_3	$m_{1\text{-}3}$	m_2 ant-post. diam.	m_2 tr. diam.	m_3 ant-post. diam.	m_3 tr. diam.	p_4 ant-post. diam.	p_4 tr. diam.
E. superstes sp. nov. Type, No. 233a, Lost Cabin beds, Wind River basin, Wyo.	—	—	—	—	—	—	—	—	42.5	25.5	8.2	7.2	8.7	6.3	8.2	5.4
E. osbornianum Cope. Type, No. 4409, Gray Bull beds, Bighorn basin, Wyo.	—	—	7.5	9.7	—	—	—	—	—	—	7.5	6.	—	—	7.5	5.5
E. ——— Topotype, No. 16174, Gray Bull beds, Bighorn basin, Wyo.	—	—	—	—	—	—	—	—	39.	24.	7.6	6.3	8.5	5.5	7.3	5.5
E. ———. No. 16045, Clark Fork beds, Clark Fork basin, Wyo.	32.	19.	6.6	9.6	6.	9.	6.5	8.5	—	—	—	—	—	—	—	—
E. ralstonensis sp. nov. Type, No. 16050, Clark Fork beds, Clark Fork basin, Wyo.	—	—	—	—	—	—	—	—	32.7 (est.)	19.	6.	5.3	—	—	6.3	4.3
E. ———. Paratype, No. 15853, Clark Fork beds, Clark Fork basin, Wyo.	—	17.5	6.5	9.	5.5	8.	—	—	—	—	—	—	—	—	—	—
E. ———. Paratype, No. 16049, Clark Fork beds, Clark Fork basin, Wyo.	—	—	—	—	—	—	—	—	—	19.2	6.2	5.3	7.	4.6	6.3	4.3
E. parvus sp. nov. Type, No. 16080, Clark Fork beds, Clark Fork basin, Wyo.	—	—	—	—	—	—	—	—	—	16.2	5.2	4.3	5.5	3.7	—	—

codus. The variations in size are considerable and there are numerous intergradations in relative antero-posterior width of the upper teeth, so that the specimens cannot readily be sorted out into well-defined groups. As in *Phenacodus* practically no progressive premolar development is shown in this genus. At least four species, indicated by size and relative proportions of teeth, are recognizable.

Ectocion osbornianum *Cope,* 1882.

Oligotomus osbornianus Cope, 1882, Pal. Bull., No. 34, p. 182; *Ectocion,* 1882 (May 20) Amer. Nat., p. 522; *E. osbornianum,* 1885, Tertiary Vertebrata, p. 696, pl. xxve, figs. 1, 10; 1887, Amer. Nat., p. 1061, fig. 25.

Type, Amer. Mus. Cope Coll. No. 4409, upper and lower jaw fragments; Gray Bull beds, Bighorn basin, Wyo. J. L. Wortman, 1881.

Distinctive characters. P_3–m_3 = 39, m_{1-3} = 24.2; p_3 not longer antero-posteriorly than p_4, simple, with protoconid and high posterior basal cusp.

I refer to this species about twenty-five specimens from the Gray Bull and about as many each from the Sand Coulee and Clark Fork beds. The widest differences between the specimens so referred is in the relative length and width of the upper molars. The type represents the condition of least antero-posterior compression of the teeth and there are gradual stages between this and a condition where the compression is very marked. The lack of good series of upper and lower teeth in association makes it difficult to determine if more than one species is represented here. The extremes of each condition occur in each horizon although the type with compressed molars is the most prevalent in the lowest beds.

Ectocion superstes sp. nov.

Type, No. 233A, a series of lower teeth, p_3–m_3, left side, with lower canine; Lost Cabin beds, Wind River basin, Wyo. J. L. Wortman, 1891.

Distinctive Characters. P_3–m_3 = 42.5, m_{1-3} = 25.5; p_3 longer antero-posteriorly than p_4 and with a tendency for a cusp to split off from the anterior ridge of the protoconid; highly developed entoconid on p_4.

This type is the only specimen of the genus in the collection coming from a level higher than the Gray Bull, and shows in the premolars a very slight progressiveness over the lower beds forms. The p_4 is rather more molariform in general appearance than in other species, due largely to the reduction of the ridge which curves forward and inward from the protoconid, To this species I provisionally refer two specimens from the Gray Bull beds (Nos. 15324 and 15325), the former a jaw fragment with molars, the latter a fragment of palate and jaw with upper and lower molars. The lower molars are about equal to those of the type in size and the upper molars show antero-posterior compression. Since the characters of the species are principally in the premolars, this reference to *E. superstes* is made with uncertainty.

Measurements, in millimeters, of upper molars, No. 15325, from the Gray Bull beds: m^3 ant. post. = 6; m^3 tr. = 10.5; m^{1-3} = 21.5; m^2 ant. post. = 7.3; m^2 tr. = 11.5.

Ectocion ralstonensis sp. nov.

Type, No. 16050, lower jaw with p_3–m_2 and roots of c–p_2, left side; Clark Fork beds, Head of Big Sand Coulee, Clark Fork basin, Wyo. Exp. 1912.

Paratypes, No. 16049, lower jaw with p_4–m_3, and No. 15853, m^{1-3}, left side; both from same locality and horizon as type.

Specific Characters. P_3–m_3 = 32.7, m_{1-3} = 19, p_3 and p_4 of about equal length; anterior part of jaw shallow, and symphyseal region slender; entoconid on p_4 relatively weak.

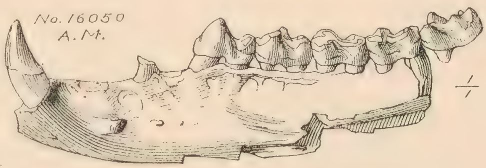


Fig. 14. *Ectocion ralstonensis,* lower jaw, external view. Type, Clark Fork beds, Clark Fork basin, Wyoming.

Distinguished from *E. osbornianum* by smaller size and relative shallowness and slenderness of ramus. The upper molars do not show the antero-posterior compression seen in some specimens referred to *E. osbornianum* from the same horizon.

The species is abundant in the Clark Fork beds, fairly so in the Sand Coulee beds, while from the Gray Bull I refer several specimens, most of which average a little larger than the type.

Two maxillæ from the Sand Coulee beds show the p^3, and in both the protocone is placed posteriorly against the p^4. Supplementary measurements from No. 16124 are: p^3–m^3 = 29.5, p^4 ant. post. diam. = 5.8, p^4 tr. diam. = 7.4.

Ectocion parvus sp. nov.

Type, No. 16080, a lower jaw fragment with m_{1-3}, left side; Clark Fork beds, Head of Big Sand Coulee, Clark Fork basin, Wyo. Exp. 1911.

Distinctive Characters. M_{1-3} = 16.2, first and last molar of equal length.

A single specimen from the lowest beds represents a species considerably smaller than *E. ralstonensis* and, hence, the smallest of the genus. In the absence of all teeth but the lower molars the measurements must suffice for specific characters. The first and second molars are much worn but they seem to show rather less crowding inward of the hypoconulids than in the other species. The jaw is much checked but indicates a relatively deeper ramus than in *E. ralstonensis*.

Distribution of Lower Eocene Species of Phenacodontidæ.

	Wyoming						N. Mex.	
	Bighorn & Wind River Basins					Evanston	San Juan Basin	
	Lost Cabin[1]	Lysite	Gray Bull	Sand Coulee	Clark Fork	Knight	Largo	Almagre
Phenacodus								
P. primævus	×		×	×	×	**X**		×
P. primævus robustus			**X**					
P. primævus hemiconus	×		**X**					?
P. intermedius	?		**X**	×	×			?
P. copei		×	**X**					×
P. vortmani	**X**	?	?					?
P. brachypternus			**X**				?	×
P. astutus								**X**?
Ectocion								
E. osbornianus			**X**	×	×			
E. superstes	**X**		?					
E. ralstonensis			×	×	**X**			
E. parvus					**X**			

X indicates horizon and locality of type.

Family MENISCOTHERIIDÆ *Cope*, 1882.

This family of condylarths was established by Cope to include the single genus *Meniscotherium* with skeleton characters more or less like those of the Phenacodontidæ, but with teeth much too highly specialized to allow of its being included in that family. *Meniscotherium* was described by Cope

[1] This is the typical Lost Cabin of the Wind River basin; no Phenacodonts have been found in the Lost Cabin horizon of the Bighorn basin.

in 1874 (*M. chamense*) and was based on a single jaw fragment, with upper molars, found by him during his explorations of the New Mexican Wasatch of that year. A few years later David Baldwin, then collecting for Marsh, obtained from the type locality and horizon the remains of many individuals of this form. Still later Cope secured from Baldwin a large amount of *Meniscotherium* which, judging from its appearance, came from the same "pocket" or bone bed as the Yale material. Both of these collections consisted of badly disorganized skeletons and more or less fragmentary skulls and jaws, all in a hard brick-red matrix. Cope selected from his material two jaw specimens, the largest and the smallest, as types of two additional species (*M. terrærubræ* and *M. tapiacitis*) and figured most of the elements of the skeleton except the feet. Marsh from his collection figured a fore and a hind foot under the new name *Hyracops socialis* and created the ordinal name Mesodactyla to include the two genera of Meniscotheriidæ. He differentiated *Hyracops* from *Meniscotherium* by the last molar being nearly or quite like the molars, by there being four vertebræ in the sacrum instead of three, and by doubtful and unspecified differences in the feet.

An examination of all of the specimens of this group in the Yale Museum [1] shows no specimens marked as types of *Hyracops* and none which shows generic differences from the *Meniscotherium* types and referred material in the American Museum collection. Two fairly complete fore feet, both with the carpals disarranged and partly obscured by matrix, apparently formed the basis for the figures of the fore foot of *Hyracops*, while a few isolated but well preserved bones of the hind foot seem to have served for the reconstruction of the pes. Compared with the feet of the composite skeleton, assembled from the materials of the Cope Collection,[2] the pes is very similar. In the fore foot one very important difference is observed; in Marsh's figures of *Hyracops* the magnum is unusually large, the front surface being nearly twice that of the lunar, and it is in articulation with the cuneiform. In the American Museum specimen the magnum is smaller than the lunar and is separated from the cuneiform by the unciform which articulates with the lunar. The centrale is not preserved but its existence in this form is indicated by the

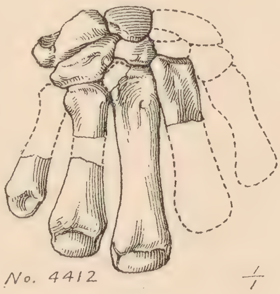


Fig. 15. *Meniscotherium terrærubræ*, carpus and metacarpus, seen from the front. From the composite mounted skeleton, No. 4412, in the Amer. Museum.

[1] The writer wishes to express his appreciation of the courtesies extended, in this connection, by Prof. Charles Shuchert of the Yale Museum.

[2] See Osborn, 1910, Age of Mammals, p. 125, fig. 39.

arrangement and facets of the lunar and magnum. In the Yale specimen the centrale is preserved. The relative proportions of the metapodials in both fore and hind feet and the form of the phalanges, including the unguals, are similar to those in the *Hyracops* figures. The differences, indicated in the carpus of the latter, seem to be due to an error in reconstruction rather than to any actual differences in the specimens. I can see no reason for considering *Hyracops* as distinct from *Meniscotherium.*

Meniscotherium *Cope,* 1874.

Syn. *Hyracops* Marsh, 1892.

Type, *M. chamense,* from the Upper Wasatch of New Mexico.

Both the geological and geographical distribution of this genus, and hence of the family, are unusual and interesting. In New Mexico it first appears in the Upper or Largo beds of the Wasatch and is one of the most abundant forms in this horizon, and serves as an excellent horizon marker. There is no trace of it from the Lower Wasatch horizon of that region,[1] while from the underlying Torrejon and Puerco formations there is no form which might in any way be considered as belonging to this group. The only specimen of the genus which has been previously recorded from outside of this rather restricted New Mexican area is a single individual from the Lost Cabin beds of the Wind River basin, Wyoming, found in 1909.[2] Two others from the same horizon, one found in 1896, the other in 1909, have recently been discovered in the collection. These specimens while extending the geographical range of the genus considerably do not extend the geological range since the Lost Cabin is considered the equivalent, or nearly so, of the Largo beds. A fourth specimen from Wyoming, collected in 1911, does, however, extend the geological range. This is a lower jaw fragment, with the fourth milk molar and first true molar, from the Clark Fork beds. While it represents a species distinct from the later forms of the Largo and Lost Cabin beds it cannot at present be excluded from the genus *Meniscotherium,* although the discovery of more complete remains may necessitate its removal. The interval between the Clark Fork and the Lost Cabin forms a considerable gap, represented by the Sand Coulee, Gray Bull and Lysite beds, totaling not less than 1300 feet of sediment, in which this genus does not occur, and it is of interest to note in this

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[1] Cope has stated that *Meniscotherium* is from the Lower Wasatch beds, but this is an error.

[2] W. Granger, Bull. A. M. N. H., XXXIII, 1914, p. 206, foot-note.

connection that two other groups of mammals in the Clark Fork, the Limnocyoninæ and the Uintatheriidæ, are also absent from these three horizons and reappear, along with *Meniscotherium,* in the Lost Cabin.

We have then the first appearance of the Meniscotheriidæ in the base of the Lower Eocene, or the top of the Paleocene, followed by a considerable period during which we get no trace of it; then, at the top of the Lower Eocene it suddenly appears again, in great abundance in the southern or New Mexican area, as a straggler in the northern district, and the family disappears finally, along with the rest of the Condylarthra, before the beginning of the Middle Eocene, or Bridger.

Characters of Meniscotherium: Teeth buno-lophoselenodont, m^{1-2} quadrate with four principal cusps and two intermediates, the posterior one of which is confluent with the hypocone and forms a metaloph; the anterior one is crescentic and separated from both protocone and paracone by deep valleys. M^3 triangular, without hypocone; p^4 like m^3 but with outer styles less pronounced. Lower molars double V-shaped with high crests and a prominent recurved metastylid,[1] hypoconulids not developed; m_3 similar to anterior molars; p_3 like molars. Canines relatively small; incisors chisel-edged. Humerus with supracondylar foramen; carpus alternating; a free centrale; unguals long and narrow hoofs, as in *Tetraclænodon.*

The composite skeleton of *Meniscotherium,* mounted in the American Museum collection, shows it to be a short stocky limbed beast with very large broad and deep head. The dorsolumbar formula is placed as 14–7 but it may have been 15–6 as in *Phenacodus.* The sacrum figured by Cope has but three vertebræ but the one used in the mount and one other in the collection have four coössified vertebræ. This variation appears to be no more than an individual or age difference. The skeleton as mounted has the vertebral column too much arched in the lumbar region and the anterior thoracic region is placed too low, which necessitated the reduction of the restored scapula to unreasonable proportions. Such fragments of the shoulder-blade as are preserved indicate that it was not widely different from that of *Phenacodus primævus.*

Considerable *Meniscotherium* material has been obtained by the recent expeditions into the New Mexican Wasatch but there is nothing which adds much to our knowledge of this form.

Three species have been described; of the two species in addition to the genotype, one is distinctly separable, while the other is differentiated by characters which seem to be of only subspecific value.

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[1] Absent in m^{1-2} of *M. tapiacitis.*

Key to Species of Meniscotherium (measurements from types).

A. Strong metastylid on all three lower molars.
  a. $m^{1-3} = 21$ mm. . . . . *M. chamense.*
  aa. $m^{1-3} = 26$ mm. . . . . *M. chamense terrærubræ.*
B. Metastylid weak on m_3, absent on anterior molars.
  b. $m^{1-3} = 17$ mm. (est.) . . . . *M. tapiacitis.*

Meniscotherium chamense, Cope 1874.

Report Vert. Fossils N. Mex. p. 8; 1877, Ext. Vert. N. Mex., p. 252, pl. lxvi, fig. 18.

Type, Coll. U. S. Nat. Mus., No. 1093, a fragment of right maxilla with the three molars; from the San Juan basin, N. Mex. E. D. Cope, 1874.

Distinctive Characters. $m^{1-3} = 21$ mm. Metastylids prominent on all three lower molars.

The type is the only specimen of this genus secured by Cope during his exploration of the New Mexican Wasatch in 1874. Subsequently his collector, David Baldwin, obtained remains of a large number of individuals, including nearly all parts of the skeleton. There is but very little association of parts in these specimens and they represent individuals of various ages and show a wide range in size.

A smaller form is represented by a single specimen, the type of *M. tapiacitis,* while of the larger species there are over fifty specimens of portions of skulls, mandibles and jaw fragments. Of these latter the types of *M. chamense* and *M. terrærubræ* represent the small and large extremes and the remaining specimens are all intermediate in size, the majority being closer to *M. terrærubræ.*

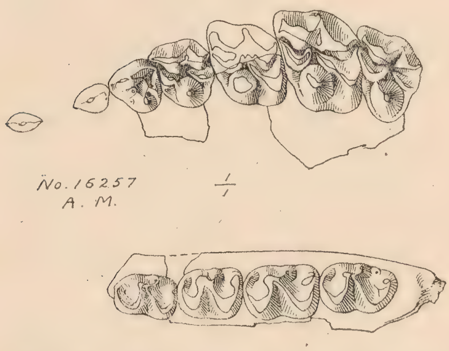

Fig. 16. *Meniscotherium chamense,* upper and lower teeth, crown views. Topotype.

I refer as belonging to *M. chamense* Nos. 16254, 16257, 4438, 4440, all fragments of maxillæ from the type locality. Of these No. 15257 approaches the type most closely ($M^{1-3} = 22$ mm.) and, since it presents both upper and lower teeth, forms a very good topotype (Fig. 16).

From the Lost Cabin beds of Muddy Creek, Wind River basin, Wyo., there is a specimen of *Meniscotherium* found by the Expedition of 1909

(No. 14785).[1] It was found in association with *Lambdotherium, Eotitanops borealis* and other characteristic Lost Cabin forms. Fragments of both maxillæ are preserved, one side supporting p^3–m^3. The teeth measure a little larger than the type of *M. chamense* but I can see no reason for not referring it to this species. On p^4 the mesostyle is rather more sharply defined than on any New Mexican specimen but this is an individual character seemingly, since all stages of development of this style are observed in the New Mexican specimens; some are without trace of it while others have it pronounced but never so highly developed as on the molars. From the typical Lost Cabin beds, on Alkali Creek, are two specimens of lower jaws (Nos. 2972, 14737), both of which are referable to *M. chamense.* The presence of these specimens of *Meniscotherium* in the Lost Cabin beds of Wyoming is a strong point in the correlation of those beds with the upper beds (Largo) of the New Mexican Wasatch.

Measurements of No. 14785 are p^3–m^3 = 34.5 mm.; m^{1-3} = 23.5 mm.

Meniscotherium chamense terrærubræ Cope, 1881.

Meniscotherium terrærubræ Cope, 1881, Proc. Am. Phil. Soc., xix, p. 493; 1885, Tert. Vert., p. 496, pll. xxv f, figs. 12–14, xxv g.

Syn. *Hyracops Socialis* Marsh, 1892.[2]

Type, Amer. Mus. Cope Coll. No. 4410, a left maxilla, with p^2–m^3 and a lower jaw fragment with p^4r. in doubtful association; Wasatch of the San Juan basin, N. Mex. D. Baldwin, 1881.

Distinctive characters: m^{1-3} = 26.5 mm.; p^3–m^3 = 37.5 mm. Lower molars as in *M. chamense.*

Cope differentiated this species from *M. chamense* by size and by the "flattened form of the external faces of the true molars and the absence of the convexity of the external bases of the crown." These differences of form I am not able to make out from the types themselves, although Cope's drawings show them.

The lower jaw fragment associated with the type probably belongs to a smaller individual, judging from other specimens in the collection where the association of upper and lower teeth is beyond question.

I refer to this large form the skull and jaws (No. 4412) used in the composite mounted skeleton, also Nos. 4413, 4417, both of which were figured by Cope in his Tertiary Vertebrata.

[1] W. Granger, *loc. cit.*, p. 206 (*M. terrærubræ*).
[2] Amer. Journ. Sci., 1892, p. 447, figs. 1, 2.

Meniscotherium tapiacitis Cope, 1882.

Proc. Am. Phil. Soc., XX, 1882, p. 470; 1885, Tert. Vert., p. 506, pl. xxv, fig. 15.

Type, No. 4425, fragmentary lower jaws with p_4–m_2r. and p_3 and m_3l; from the Wasatch of the San Juan basin, "Alto la Zerta", N. Mex. D. Baldwin Coll'r.

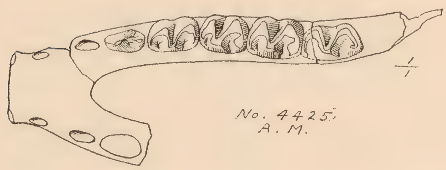

Fig. 17. *Meniscotherium tapiacitis*, lower jaw, crown view. Type specimen.

Distinctive characters: m^{1-3} = 17 mm. (est.); lower molars with metastylid slightly developed on m_3, absent on other molars.

This diminutive species is represented by the type only, and there are no specimens in the collection, except the one described below, which are intermediate in size between it and the type of *M. chamense*.

Meniscotherium(?) **priscum** sp. nov.

Type, No. 16145, a lower jaw fragment with dm_4–m_1 left; from the Clark Fork beds, Head of Big Sand Coulee, Clark Fork basin, Wyo. Exp. 1911.

Fig. 18. *Meniscotherium* (?) *priscum*, fourth milk molar and first true molar, crown and internal views. Type, Clark Fork beds, Clark Fork basin, Wyoming.

Distinctive characters: dm_4–m_1 = 11.8 mm., m_1 ant. post. = 5.5 mm. tr. = 4.5 mm.; prominent metastylid on first molar.

There are no characters in the two teeth present in this specimen to exclude it from the genus *Meniscotherium* but it would not be surprising, considering the low horizon from which it comes, if more complete material forced the establishment of a new genus. It is true that *Phenacodus* and *Ectocion* both run through the same vertical range with very little change, but *Meniscotherium* is a much more specialized form than either of these.

The present species is slightly larger than *M. tapiacitis* and differs from it in having the well developed metastylid; from the larger forms it is readily separable by size.

Distribution of species of Meniscotheriidæ.

	Wyoming					N. Mex.	
	Lost Cabin	Lysite	Gray Bull	Sand Coulee	Clark Fork	Largo	Almagre
Meniscotherium							
M. chamense	×					**X**	
M. chamense terrærubræ						**X**	
M. tapiacitis						**X**	
M(?). priscum					**X**		

X indicates horizon and locality of type.

59.82(8)

Article XI.— DESCRIPTIONS OF PROPOSED NEW BIRDS FROM CENTRAL AND SOUTH AMERICA.

By Frank M. Chapman.

This paper is, in effect, the fourth preliminary publication on collections which the American Museum has in recent years received from Colombia. Since, however, the identification of this material has in some instances led to the discovery of apparently undescribed forms beyond the limits of Colombia, it has been deemed inadvisable to employ here the restricted title used for the preceding papers [1] in this series.

For the loan of specimens used in comparison I am indebted to the United States National Museum, through Dr. C. W. Richmond, the Field Museum, through Mr. C. B. Cory; the Academy of Natural Sciences at Philadelphia, through Dr. Witmer Stone; the Brooklyn Institute, through Mr. R. C. Murphy; the Carnegie Museum, through Mr. W. E. C. Todd, and to Mr. Thomas E. Penard, of Arlington, Mass.

The color terms employed will be found figured in Ridgway's 'Color Standards and Nomenclature' (Washington, 1912).

Odontophorus guianensis panamensis subsp. nov.

Char. subsp.— Distinguished from all its allies by its white or whitish chin and browner throat, the feathers of the front, and, to a lesser degree, sides of which have one or two white or whitish bars or spots; it further differs (1) from *O. g. guianensis* in having cinnamon-rufous instead of buffy ear-coverts, and (aside from this character) in having the brown markings of the head much reduced in intensity and extent; (2) from *O. g. marmoratus* in having much more brown or cinnamon-rufous about the head; (3) from *O. g. castigatus* in having the back anteriorly grayish (as in the more southern forms) instead of brownish; the crown and chestnut-brown markings of the head paler.

Type.— No. 45165, Am. Mus. Nat. Hist., ♂ ad., Panama R. R. Line; McLeannan & Galbraith.

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[1] 'Diagnoses of apparently new Colombian Birds, I.' Bull. A. M. N. H., Vol. XXXI, 1912, pp. 130–166.
'Diagnoses of apparently new Colombian Birds, II.' Bull. A. M. N. H., Vol. XXXIII, 1914, pp. 167–192.
'Diagnoses of apparently new Colombian Birds, III.' Bull. A. M. N. H., Vol. XXXIII, 1914, pp. 603–637.

Remarks.— Panama specimens of this species have been referred by Salvin & Godman (Biol. Cent. Am. Aves, III, p. 309) and Ogilvie-Grant (Cat. B. M. Bds., XXII, p. 433) to the 'Bogotá' form *O. g. marmoratus.* The fact, however, that both these authors refuse to recognize the strongly marked, and perhaps specifically distinct, west Panama form, *Odontophorus castigatus* Bangs, indicates that due weight was not given to the markings by which the races of this species may be distinguished.

The twenty-seven specimens before me apparently show that in northern South America there exist at least four subspecies of *Odontophorus guianensis,* the characters of which may be summarized as follows. I find no constant differences in size.

1. *Odontophorus guianensis guianensis* (Gmel.). Type-locality "Cayenne."

Char. subsp.— Ear-coverts buffy; chin brown or brownish, sides of the head rich chestnut-brown; throat grayish.

Range.— Guianas southward to the Amazon.

Specimens examined.— *British Guiana:* Potaro Landing, 3; *Brazil:* Santarem, 1 (this specimen has more rufous on the throat than in the Guiana birds).

2. *O. g. marmoratus* (Gould). Type-locality 'Bogotá.'

Char. subsp.— Chestnut-brown markings of the head much reduced or entirely wanting; chin grayish or brownish; ear-coverts umber sometimes with a chestnut tinge.

Range.— 'Bogotá' region including the Tropical Zone at the eastern base of the Eastern Andes upward to an altitude of 4500 ft., and forested parts of the lower Magdalena Valley.

Specimens examined.— *Colombia:* Buena Vista (above Villavicencio, 4500 ft.), 1; La Murelia (600 ft.), Caquetá, 1; Puerto Valdivia (360 ft.), Antioquia, 2. (The two specimens from east of the Andes have no chestnut-brown on the head; the two Antioquia specimens have the ear-coverts and sides of the head tinged with chestnut-brown and thus more nearly conform to the description of Gould's type which may have come from the western instead of the eastern side of the Eastern Andes.

3. *Odontophorus guianensis panamensis* Chapm. Type-locality, Panama R. R. Line.

Char. subsp.— Chin white or whitish; throat with white or whitish spots or bars; ear-coverts cinnamon-rufous; brown markings of the head paler and less extended than in *guianensis*, more evident than in *marmoratus.*

Range.— Panama (eastward to the Atrato, westward to the range of *castigatus*).

Specimens examined.— Panama R. R. Line, 5; Nata Coclé, 1; Tapaliza, 5; Tacarcuna, 4.

4. *O. g. castigatus* (Bangs). Type-locality, Divala, Chiriqui.

Char. subsp.— Back anteriorly brownish of the same general tone as rest of the upperparts.

Range.— Western Panama and southwestern Costa Rica.

Specimens examined.— Chiriqui, 5.

Odontophorus pachyrhynchus Tschudi, of Peru, is currently synonymized with *O. g. marmoratus,* but in view of the racial variability of the species it doubtless is a valid form. I have, however, seen no specimens.

Rhynchortyx cinctus australis subsp. nov.

Rhynchortyx cinctus (nec Salvin) HART., Nov. Zool. IX, 1902, p. 600 (Bulún, Rio Bogotá, Pambilar, N. W. Ecuador); HELLM., P. Z. S. 1911, p. 1207 (Sipi, Col.).

Char. subsp.— Similar to *R. c. cinctus* but coloration throughout darker; male with the breast slightly darker gray, the abdominal region and, particularly, the flanks and under tail-coverts deeper ochraceous buff; the crown, margins to the feathers of the back, markings to tertials richer, more chestnut; bars on the outer vanes of secondaries hazel rather than ochraceous-buff; female differing from the female of *cinctus* much as does the male, the richer color of the markings of the inner wing-quills being especially noticeable.

Type.— No. 117555, Am. Mus. Nat. Hist. ♂ ad., Barbacoas, Col., Aug. 10, 1912; W. B. Richardson.

Range.— Tropical Zone of western Colombia (Baudo, 2500 ft., Bagado, 1000 ft., Andagueda, 1000 ft., Sipi, 150 ft., Barbacoas, sea-level) and northwestern Ecuador.

Remarks.— This form is based on six males and three females from western Colombia for comparison with which I have five males and a female from Nicaragua and a male from Panama.

Hartert and Hellmayr (*l. c.*) have already shown that *R. cinctus* and *R. spodiostethus* are respectively the female and male of the same species, the former name having two years priority.

Individual variation in color in the male appears to be largely confined to the rump. In true *cinctus* the prevailing tone is ochraceous-buff overlaying gray, with some darker markings and, in three specimens, a strong vinaceous tinge.

In *australis* our specimens show an even wider range. One has the rump largely gray with black and white dots; in a second it is largely ochraceous-buff, a third has the dominant tone of this part russet, and others are variously intermediate.

Similar variations are shown in the rump of the female, in which, also, the breast varies greatly in intensity of color.

These variations, however, in no way affect the differential characters ascribed to the race here proposed.

Three specimens from the upper Atrato region agree with those from Barbacoas. I have no topotypical (Veragua) examples but the fact that a male from Panama agrees with our series from Nicaragua indicates that the latter are typical.

A newly hatched chick collected by Mrs. Kerr in the Baudo Mountains June 20, 1912, is presumably the young of this species. The upperparts are uniform bright mars-brown, the forehead, throat and sides of the head somewhat brighter, the underparts are decidedly paler. Aside from a faint suggestion of bars on the thighs, there are no markings.

Columba subvinacea peninsularis subsp. nov.

Char. subsp.— In general coloration resembling *Columba subvinacea bogotensis* (Berl. & Lev.), the olivaceous of the upperparts being more or less mixed with or washed with dark vinaceous; but the inner margins of the wing-quills are strongly rufous, except at the ends of the feathers; size much smaller, about that of *C. s. berlepschi.*

Type.— No. 120302, Am. Mus. Nat. Hist., ♂ ad., mountains above Cristobal Colon (alt. 1500 ft.), Paria Peninsula, Venezuela, June 13, 1913; L. E. Miller.

Remarks.— This interesting form, based on three specimens all from the type-locality, apparently represents the most eastward extension of the *subvinacea* type. Compared with true *subvinacea,* from Costa Rica, it is smaller and the general coloration is much more olivaceous and nearer that of *C. s. bogotensis.* The inner margin of the wing-quills, however, are quite as rufous as in *subvinacea,* but the under wing-coverts are more vinaceous than in that form. Roughly speaking, therefore, *peninsularis* has the general coloration of *bogotensis* with the wing-lining of *subvinacea,* but in size it is smaller than either.

Hellmayr and von Seilern record *C. s. subvinacea* [1] from Las Quiguas, near San Esteban in north central Venezuela but the measurements of their specimen indicate that it is not the form here described.

Measurements.

Name	Locality	Sex	Wing	Tail	Tarsus	Culmen
C. s. subvinacea,	San José, Costa Rica,	♀	162	130	23	14
C. s. bogotensis,	La Candela, Colombia,	♂	169	147	23	14
" " "	" "	♀	175	138	23	14
C. s. peninsularis,	Cristobal Colon, Ven.	♂	149	118	21	13
" " "	" " "	♂	142	112	19	11.5
" " "	" " "	♀	147	119	20	11.5
C. s. zuliæ [2]	Zulia, "	♂	164	127	—	13
" " " [3]	Las Quigas, "	♂	167	137		14
C. s. berlepschi,	Manavi, Ec.	♂	147	120	21.5	12
" " "	"	♂	144	118	21.5	12.5

[1] Archiv für Naturg., 1912, p. 159. Doubtless the same as the subsequently described *Columba subvinacea zuliæ* Cory (Field Mus. Pub. 182, p. 295, Feb. 1915).
[2] Ex Cory.
[3] Ex Hellm. & Von Seilern under *C. s. subvinacea.*

Chæmepelia rufipennis caucæ subsp. nov.

Chæmepelia rufipennis rufipennis Todd (nec Bonaparte; Cauca Valley specimens only), Ann. Carn. Mus. VIII, 1913, pp. 586, 602.

Char. subsp.— Male not certainly distinguishable from the male of *C. r. rufipennis* but averaging paler below and browner above; female conspicuously different from the female of that race; the upperparts rather light Saccordo's umber, practically without trace of vinaceous, except upon the rump and upper tail-coverts where it is much less pronounced than in *C. r. rufipennis;* the crown usually concolor with the back; the rectrices, upper wing-coverts and inner wing-feathers externally, the underparts, particularly the flanks and lower tail-coverts, with less vinaceous tawny than in *C. r. rufipennis.*

Type.— No. 108688, Am. Mus. Nat. Hist. ♀, La Manuelita, near Palmira, Cauca Valley, Col., April 15, 1911; F. M. Chapman; W. B. Richardson.

Range.— Tropical Zone in the Cauca Valley (and arid upper Dagua Valley ?), Colombia; ranging upward to the lower border of the Subtropical Zone at about 6300 feet.

Remarks.— Four females from the Cauca Valley (Cali, La Manuelita and below Miraflores) and the slopes rising from it all show, on comparison with an adequate series from Santa Marta, the excellent characters on which this form is based.

The Races of Leptotila rufaxilla.

The name *Leptotila rufaxilla* (Rich. & Bern.) is currently applied to a common Dove which ranges over northern South America east of the Andes. In attempting, however, to identify our Colombian specimens, I find that our forty-four specimens of this species from north of the Amazon apparently represent no less than four forms of which two appear to be undescribed.

This species has also been recorded from south of the Amazon, but beyond indicating that these records are not based on true *rufaxilla,* my material from this region is too limited to warrant the forming of conclusions.

The northern forms may be characterized as follows:

Leptotila rufaxilla rufaxilla (Rich. & Bern.).

Columba rufaxilla Rich. & Bern., Act. Soc. Hist. Nat. Paris, I, 1792, p. 118 (Cayenne).

Char. subsp.— Darker above (olive-brown with more or less iridescent natal-brown) paler vinaceous below (light vinaceous-fawn), crown deeper bluish-gray (dark gull-gray) than any of the following forms, the forehead gull-gray, with occasionally a slight buffy tint at the base of the bill; the hazel lining of the wings somewhat deeper in color and more restricted than in the following forms.

Range.— Guianas southward to the lower Amazon.

Remarks.— My series of thirteen Guianan specimens of this race vary widely in the color of the upperparts. In some the prevailing color above is dark olive, in others it is shining natal-brown or natal-brown with purplish reflections. The underparts are more constant in color, and the light vinaceous-fawn (with sometimes a grayish cast) of the breast cannot be matched by any specimen in our series of the remaining races.

Specimens examined.— *Dutch Guiana:* Vicinity Paramaribo (Coll. T. E. Penard), 5; *British Guiana:* Demarara, 1; Rockstone, 1; Potaro River, 6. *Brazil:* Santarem, 1. (This specimen is paler above than the average Guianan specimen with which below it agrees exactly. The head is missing.)

Leptotila rufaxilla hellmayri subsp. nov.

Char. subsp.— Most nearly resembling *L. r. dubusi* (Bonap.) but upperparts averaging more cinnamomeus, sides and posterior margin of the throat with more pinkish cinnamon, whitish throat-patch much more extended posteriorly, forehead whiter, blue-gray of the crown wider, reaching back to the occiput; wings and tail longer. Readily distinguished from *L. r. rufaxilla* by its always more cinnamomeus upperparts, richer vinaceous underparts, paler crown and whiter forehead.

Type.— No. 59494, Am. Mus. Nat. Hist. ♂ ad., near Princestown, Trinidad, March 10, 1893; F. M. Chapman.

Range.— Island of Trinidad and northeastern Venezuela.

Remarks.— This form is so strongly differentiated from true *rufaxilla* that not one of our fourteen specimens of it could for a moment be mistaken for any one of our fourteen specimens of that form. The range of variation in the color of the upperparts is about as extensive as in *rufaxilla,* some specimens being largely olive above, while others are almost pure light cinnamon-brown, but the olive is always paler than in *rufaxilla* and the cinnamon-brown specimens bear small resemblance to the purple tinted examples of *rufaxilla.*

In general coloration specimens of *hellmayri* can sometimes be matched by specimens of *dubusi,* but the former always has the white of the throat and gray-blue of the crown more extended posteriorly, and is larger.

I take pleasure in dedicating this race to that distinguished student of the Trinidad avifauna, Dr. Carl E. Hellmayr.

Specimens examined.— Trinidad, 12; *Venezuela:* Cristobal Colon, Paria Peninsula, 2. (These two birds are paler both below and above and on the nape than any of our Trinidad specimens. It may develop that *hellmayri* is an insular form.

Leptotila rufaxilla pallidipectus subsp. nov.

Char. subsp.— Differs from all the known forms of this species in its much paler, buff-tinted (vinaceous-buff) breast, paler light brownish olive back, practically without purplish reflections; more grayish, less iridescent occiput and nape; the gull-gray of crown as restricted as in *L. r. dubusi*, the throat as extensively white as in *hellmayri;* agreeing in size with the former.

Type.— No. 121397, Am. Mus. Nat. Hist., ♂ ad., Buena Vista (alt. 4500 ft.), Eastern Andes above Villavicencio, Col., March 3, 1913; F. M. Chapman.

Range.— Tropical Zone at the eastern base of the Eastern Andes in Colombia (and Venezuela?) probably north of Amazonian forest-line at the Guaviare River.

Remarks.— The strongly marked characters on which this form is based are well shown by four specimens, three of which are from Villavicencio, at the foot of the mountains below Buena Vista. Although geographically nearer *dubusi* than is *hellmayri*, the last two more nearly resemble one another than *pallidipectus* does either. Its paler coloration may doubtless be attributed to the less humid conditions prevailing north of the Amazonian forest line, which, in Colombia conforms approximately with the Guaviare River. About Villavicencio it was found in the growth bordering streams and under these conditions its range may extend eastward on the llanos.

Specimens examined.— *Colombia*: Buena Vista, 1; Villavicencio, 3.

Leptotila rufaxilla dubusi (*Bonap.*).

Leptoptila dubusi Bonap., Consp. Av., III, 1854, p. 74, (Rio Napo, Ecuador).

Char. subsp.— Most nearly resembling *L. r. hellmayri* but upperparts averaging more olive, less cinnamomeus, front and sides of the throat and postocular region with less pinkish cinnamon; white of throat more restricted, confined largely to the chin; forehead darker; gull-gray of crown less extended posteriorly, reaching little if any behind the eyes; wings and tail shorter. Easily distinguished from *L. r. rufaxilla* by its more cinnamon upperparts, paler crown, deeper vinaceous breast, small white throat area, and smaller size.

Range.— Tropical Zone at the eastern base of the Eastern Andes from the Guaviare River in Colombia southward into Ecuador eastward through the Amazonian region to the western border of the range of *L. r. rufaxilla.*

Remarks.— I have seen no specimens of *rufaxilla* from the Napo region but Bonaparte's description (*l. c.*) and the close resemblance existing between the avifauna of the Caquetá and Napo regions leave little doubt that our series of ten specimens from La Murelia and Florencia should be referred to *L. r. dubusi*. It is true that after an examination of Bonaparte's type Salvadori (Cat. B. M., XXI, p. 552) refers it to *L. rufaxilla* but this conclusion is obviously due to the lack of proper material, the series at my command showing beyond question, that the form from the western margin of Amazonia is quite unlike the Guiana bird.

Specimens examined.— La Murelia, 9; Florencia, 1; Foot of Mt. Duida, 1.

Measurements of Males.

	Locality	Wing	Tail	Tarsus	Culmen
L. r. rufaxilla	Paramaribo	141	95	29.5	15
" " "	Potaro R., Brit. Guiana	143.5	103.5	30	15
" " "	" "	140	100	30	15
L. r. hellmayri	Trinidad	140	100	29	16.5
" " "	"	136.5	98	29	15.5
" " "	"	141	97.5	29	16.5
" " "	Cristobal Colon, Venez.	143	97	29.5	16
" " "	" " "	140	93	29.5	16
L. r. dubusi	La Murelia, Col.	137	95	29	16
" " "	" "	131	95	29	16
L. r. pallidipectus	Buena Vista, "	135	96	29	15

Measurements of Females.

	Locality	Wing	Tail	Tarsus	Culmen
L. r. rufaxilla	Paramaribo	140	97	29	16
" " "	"	138	92	28	15
" " "	"	139	95	29.5	16
" " "	Potaro R., Brit. Guiana	144	97	32	16
L. r. hellmayri	Trinidad	141.5	99	30	16
" " "	"	138	99	30.5	16
" " "	"	140	96	30	16
L. r. dubusi	La Murelia, Col.	131	91	29	15
" " "	" "	131	92	29.5	16
" " "	" "	134	93	30	16
L. r. pallidipectus	Villavicencio, Col.	131	93	29	15
" " "	" "	134	94	28.5	15.5

Asio flammeus bogotensis subsp. nov.

Char. subsp.— Similar to *A. f. flammeus* but ochraceous markings above much more restricted or, in places, obsolete, the upperparts, therefore, much darker; tarsi and toes less heavily feathered, the feathered area on the latter less extended toward the nail; size averaging smaller; bill somewhat heavier and wholly black.

Type.— No. 121,454, Am. Mus. Nat. Hist., ♀ ad., Savanna of Bogotá, Col., Feb. 19, 1913; F. M. Chapman. Wing, 304; tail, 137; tarsus, 54; culmen, 32 mm.
Range.— Savanna of Bogotá, Colombia.

Remarks.— Only the type of this interesting and well-marked race was secured by our expedition. While comparison with a large series of *A. f. flammeus* indicated its distinctness, it was deemed inadvisable to describe it without additional specimens. Our good friend Hermano Apolinar Maria, Director of the Instituto de la Salle of Bogotá, who has rendered us such valuable assistance on similar occasions, was therefore appealed to and he promptly sent two more females both collected on the Bogotá Savanna.

These two birds agree with the type and thus confirm the validity of the characters on which the proposed new race is based.

Other than the marked changes in appearance caused by the diminution of the ochraceous markings on the feathers of the upperparts, I observe no difference in pattern of coloration between *bogotensis* and true *flammeus*. Both have the markings of the wing-quills under wing-coverts, and underparts essentially the same, and beyond a slight difference in size are therefore to be distinguished only by the much darker color above and less heavily feathered feet of *bogotensis*.

In the restriction of the ochraceous markings above, *bogotensis* is nearer to *portoricensis* than to *flammeus*. Our two specimens of *portoricensis* are not so dark above, the wing-quills have more brown basally, and the under wing-coverts, as stated by Ridgway in his original diagnosis (Bull. U. S. N. M., IV, 1881, p. 366), are "nearly immaculate ochraceous."

In the darkness of its upperparts *bogotensis* bears some resemblance to *galapagoensis*, a fact to which Sharpe (Cat. B. M. Bds., II, 1875, p. 239) called attention many years ago. The latter, however, is smaller, has more ochraceous in the upperparts, has the flanks barred, and tarsi marked with fuscous.

The limited number of specimens of this widely distributed owl which I have seen from Argentina appear to be referable to true *flammeus* (though the under wing-coverts have fewer marks). This form occurs at sea-level, therefore, both in the North Temperate and South Temperate Zones, while *bogotensis* occupies that little Temperate Zone island which is formed by the Savanna of Bogotá in the Eastern Andes of Colombia.

Remarks on Certain South American Forms of the Genus Cerchneis.

In identifying our large collection of Colombian Sparrow Hawks, I was led also to take up specimens of this bird which we have recently received from Ecuador, Peru and Chile. This necessarily widened my survey of the group and without attempting a revision of its South American members, I present here merely the conclusions reached in naming the specimens contained in our collections.

I have seen no specimens of *Cerchneis sparverius brevipennis* Berl.,[1] *C. s. distincta* Cory,[2] or *C. s. margaritensis* Cory.[3]

The numerous forms of *Cerchneis sparverius*[4] appear to fall naturally into three main geographic divisions, North American, West Indian, and South American. The West Indian division, represented by *Cerchneis sparverius antillarum,* is more strongly differentiated from both the North and South American types than, generally speaking, they are from each other. The male has the underparts more heavily spotted than in any other form, except the insular *C. s. fernandensis,* the wing-coverts strongly marked with black, and the tail feathers, including the central pair, more or less barred with black. The female is strongly barred with black above and has the markings of the underparts blacker than in any other form examined. All the specimens in my small series of this race (three males, five females) have the crown largely rufous. This fact, in connection with the occasional presence of small black markings on the central rectrices in North American specimens, suggests that *antillarum* is more closely related to the North American than to the South American group.

The North American group extends as far southward as the Canal Zone in Panama whence we have a pair of birds which I refer to *Cerchneis sparverius sparverius.* I also provisionally refer a female in worn plumage, taken December 29, 1911, at Noanama, western Colombia, to this race.

There are no characters by which members of the North American group can always be distinguished from members of the South American group. The former, however, practically always have the crown with a more or less well developed rufous patch, while males of the latter are usually without rufous in the crown, or, if it be present, it occupies in both sexes a much smaller area than in North American specimens.

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[1] J. f. O., 1892, p. 91 (Curaçao).
[2] Field Mus. Pub. 182, 1915, p. 297 (Boa Vista, Rio Branco, Brazil).
[3] *Ibid.*, p. 297 (Margarita Island).
[4] Omitting here *Cerchneis dominicensis* of Cuba, Hayti and Santo Domingo.

Mr. W. DeW. Miller, after an examination of our North American series, reports that of seventy-six males only one lacks rufous on the crown, while in all but three or four the rufous patch is large and conspicuous. Of eighty-three females the rufous crown-patch is present in all. It is reduced to a trace in one, and small and mixed with gray in three or four, but is large and conspicuous in seventy-seven.

On the other hand, I find that in seventy-eight South American males it is essentially absent in sixty-five, and more or less evident in thirteen. In the females it is more developed, only thirty out of fifty-seven being without it, but in the remaining twenty-seven, only three or four approach the average North American specimens.

In North American specimens the outer rectrix more frequently has two or more bars than in South American specimens. This character, however, is too variable to be of constant diagnostic value and I mention it chiefly because it at times has been used in diagnosis. An examination of our males gives the following results: Mr. Miller reports that of seventy-six North American specimens, nineteen have only a subterminal bar in the outer rectrix, while fifty-seven have two or more bars on this feather. Among seventy-eight South American males I find that thirty-four have only the subterminal bar, while forty-four have two or more bars. This variability, it should be added, is shown, in a greater or less degree, by all the races of which adequate series have been examined.

Geographical variation is more extensive in the South American than in the North American group. In the latter size and intensity of color are the differentiating characters. In the former there are striking differences in pattern as well as variations in size and color.

Cerchneis sparverius isabellina (*Swains.*).

Falco isabellina SWAINS., Anim. in Menag., 1837, p. 281 (Demerara, Br. Guiana).

Char. subsp.— Palest of the Sparrow Hawks; the breast and upper abdomen in the adult male light pinkish cinnamon or white washed with pinkish cinnamon; the ventral region, thighs and lower tail-coverts white; the underparts usually without spots; white bars in the primaries wider than black ones, the terminal white areas usually confluent on all but the outer primary; crown with a rufous patch in one out of six specimens; the nape with or without black; female with the crown exceedingly pale, washed with rufous centrally in two of four specimens; the underparts whitish more or less streaked with umber.

Range.— Eastern Venezuela east to the Guianas.[1]

[1] Two specimens from Turbaco near Carthagena, Colombia, resemble our specimens from eastern Venezuela. Whether they represent an undescribed form or the westward extension of this race through the arid coastal zone I am unable to say.

Remarks.— Of six males and four females only one male (from British Guiana) may be considered as topotypical. Unfortunately it is in much too worn plumage to represent the characters of its race satisfactorily. The grayish terminal tail-band is practically worn off, the quills badly frayed, and the color both above and below evidently much faded. The underparts are decidedly paler than in the five males from Eastern Venezuela, but the crown is much darker. Possibly the Venezuela birds are separable but with only this one poor specimen from Guiana for comparison it is clearly not possible to determine their status conclusively. It is evident, however, that they are much nearer to *isabellina* than to *ochracea*.

Specimens examined.— *Venezuela:* Caicara, Orinoco, 1♂, 1♀; Maripa, Rio Caura, 3♂♂, 2♀♀; San Antonio, Bermudez, 1♂, 1♀; British Guiana, 1♂.

Cerchneis sparverius ochracea *Cory.*

Cerchneis sparverius ochracea Cory, Field Mus. Pub. Nat. Hist. 182, 1915, p. 298 (Colon, Tachira, W. Venezuela).

Char. subsp.— Similar to *C. s. isabellina* [1] but larger and deeper in color; the underparts, except throat, much more richly colored, pinkish cinnamon instead of light pinkish cinnamon; this color appearing more or less strongly on the abdomen, flanks, and thighs; male with the black bars on the wing-quills wider, the white areas correspondingly more restricted; female more heavily streaked below. Closely resembling *C. s. æquatorialis* in color, but much smaller.

Range.— Eastern Colombia from the eastern slopes of the Central Andes, across the upper Magdalena Valley over the Eastern Andes (ascending to the Temperate Zone) to the llanos, north and northeast to Paramo de Tama, Lake Maracaibo, and Merida, Venezuela.

Remarks.— This form is represented by eighteen males and thirteen females in our collection, chiefly from the Bogotá region, and by two males, including the type, and two females from the Field Museum loaned me by Mr. Cory. It appears not to vary in color or in size with altitude and ranges from the Tropical to the Temperate Zone. There is, however, considerable individual variation in both color and pattern.

The type appears to be more richly colored than the average specimen but can be closely matched by five or six of our males. Several males are much paler below and more nearly resemble males from the Lower Orinoco, which I have provisionally called *isabellina.* Of twenty males, nine are practically spotless below, in the remaining eleven there are from two or three, to half a dozen small spots on each flank.

[1] As this form is represented by the specimens mentioned above.

The outer pair of tail-feathers is barred black and white in eleven males and largely rufous with a grayish outer web and tip and a single subterminal black bar in nine specimens. Both these types of coloration occur in specimens from the same locality.

The type has fewer spots in the upper wing-coverts than most of our Colombian birds, but I believe this to be due to individual variation. The back has, as a rule, but few bars and in six specimens is practically unbarred. In six of twenty males there is more or less rufous on the crown (in only one, a male from Paramo de Tama, does it form a 'patch'), the remaining fourteen have the crown dark slaty with essentially no rufous and but little or no black on the nape.

The terminal white areas on the outer primaries are confluent in the second or third (or both) quills, in fifteen specimens, disconnected in five specimens.

In the female, rufous appears more frequently in the crown than in the male. Only three of fifteen specimens are without it, while in three others it forms a well-developed 'patch.' Females in juvenal, or nestling plumage, are as deeply colored below as the most richly marked males and the streaks on the underparts are less sharply defined than in mature birds. On the other hand, what I assume to be fully adult birds, are pale fulvous heavily streaked with umber below, and the variations between these two extremes are doubtless attributable to age. A female from the type-locality is less heavily streaked below and less definitely barred on the tail than Colombian specimens.

Specimens examined.— *Colombia:* Villavicencio, 1 ♀; Caquezá, 1 ♂; El Piñon, 1 ♀; 'Bogotá' skin, 1 ♂; La Herrera (s. of Bogotá), 1 ♂, 1 ♀; Fusugasugá, 1 ♂, 1 ♀; La Olanda (20 m. n. e. Bogotá, 8500 ft.) 5 ♂♂, 2 ♀♀; Tena, 1 ♂; near Bogotá, 1 ♂, 1 ♀; Honda, 4 ♂♂, 1 ♀; Andalucia (w. slope, 3000 ft.), 3 ♂♂, 3 ♀♀; Rio Toché, 1 ♀; Paramo de Tama,[1] 1 ♂, 1 ♀; *Venezuela*: Colon, Tachira,[1] 1 ♂, 1 ♀; Merida, 1 ♂, 3 ♀♀.

Cerchneis sparverius caucæ subsp. nov.

Char. subsp.— Agreeing in size and general intensity of color with *C. s. ochracea* but male with the sides conspicuously spotted; crown darker, nape blacker, terminal white areas on primaries usually not confluent; female with the crown and nape averaging darker; male resembling *C. s. sparverius* in the coloration of the underparts, but crown usually without rufous, subterminal black bar on central rectrices, much narrower; back with fewer bars; female darker above and more washed with

[1] From the Field Museum.

rufous below than the female of *C. s. sparverius*, the outer rectrices, quill-markings and outer border of outer feather more rufous, the crown darker and with less or with no rufous.

Type.— No. 108740, Am. Mus. Nat. Hist., ♂ ad., La Manuelita (near Palmira), alt. 3500 ft., Cauca Valley, Colombia, April 12, 1911; F. M. Chapman and W. B. Richardson.

Range.— Western Colombia, from the western slopes of the Central Andes westward; south into subtropical and tropical western Ecuador (and western Peru?).

Remarks.— This form is based on four males and five females. I also refer to it a male from Gualea, in the Subtropical Zone of Ecuador and two males from Huigra (alt. 4000 and 5000 ft.), in southern Ecuador. A male from the junction of the Chanchan and Chiguancay rivers, is nearer *æquatorialis* in size but resembles *caucæ* in color.

The Colombian males appear to be adult but all have the sides conspicuously spotted with black. Not one has the terminal white areas on the second or third outer primaries fused, while in fifteen of eighteen males of *ochracea* these markings are confluent.

The male from Gualea, as the appended table of measurements shows, slightly approaches *æquatorialis* in size, but although apparently adult, it has the sides heavily spotted; whereas, if I am correct in my assumption that the spots on the underparts of *æquatorialis* are due to immaturity, that form has the underparts with but few spots in the adult.

Specimens examined.— *Colombia:* Laguneta, 1 ♀; Miraflores, 1 ♂, 1 ♀; La Manuelita, 1 ♂, 1 ♀; Cali, 1 ♂; La Florida, 1 ♂; Popayan, 1 ♀; *Ecuador:* Gualea, 1 ♂; Huigra, 2 ♂♂; *Peru:* Lima, 1 ♀.

Cerchneis sparverius æquatorialis (*Mearns*).

Falco sparverius æquatorialis Mearns, Auk, IX, 1892, p. 269 ("Guayaquil,"— *errore* — Ecuador).

Char. subsp.— Size large; tail long; color much as in *C. s. ochracea*, but the sides in the male with usually a few, small elongate spots, the nape darker; terminal white areas in the second and third outer primaries usually fused.

Range.— Temperate Zone in Ecuador and southward.[1]

Remarks.— Insufficient material and the fact that both the male and female specimens designated by Dr. Mearns as types of this form are without locality, make it difficult to treat the Sparrow Hawks of Ecuador satisfactorily.

Since their measurements indicate that the types represent different

[1] I have only two males from this zone in Peru, taken at Cuzco. They average larger than *cinnamomina* and have the underparts more deeply colored. They, however, agree with that form in having the underparts spotted and the tail tipped with rufous.

forms (the female is smaller, instead of larger than the male, and is referable, probably to *caucæ*) we may accept the male as *the* type of the race and make our comparisons with it alone. This specimen (No. 101309, U. S. Nat. Mus.) is labelled "Guayaquil, Ecuador, 1884; Dr. Wm. H. Jones, U. S. N." It appears, however, that with other birds it was merely bought in Guayaquil, and was doubtless collected in the higher interior. Dr. Richmond writes me from the National Museum that the collection presented by Dr. Jones was accompanied by a letter from which he sends me the following extracts:

> ". . . . The birds alone I think are worth the freight of the consignment. I rec'd these from Mr. Cartwright Agt. P. S. N. Co. Guayaquil as a gift. He is constantly receiving them from the interior of Ecuador, ..."

Dr. Richmond adds:— "On the invoice accompanying the above letter, I find this note":

> ". . . . Besides the above there are 80 birds from Mr. Cartwright's collection at Guayaquil. These are all natives of Ecuador & found in various parts of the country. Did not have time to obtain the native names nor the locality where each species came from."

Further evidence indicating that the bird came from the interior is furnished by the bird's size which agrees with that of specimens from the Temperate Zone (see table of measurements beyond). In color, however, the type of *æquatorialis* has the sides more heavily spotted, the back more barred than in any one of our four adult males from Mt. Pichincha and Mt. Chimborazo. It is my opinion, however, that the spotted sides and barred back of the type are due, at least in part, to its immaturity, and its almost wholly yellow (instead of basally yellow, apically plumbeous) mandible also indicates that it is not adult.

A male from Gualea, in the Subtropical Zone of the Pacific slope, while somewhat larger than specimens of *caucæ* from the Cauca Valley, is much nearer to them, especially in the length of tail and tarsus, than to specimens of the Temperate Zone. It has the sides heavily spotted and appears to be fully adult.

Two males collected by Rhoads at Huigra (alt. 5000 ft.) are also nearer *caucæ* in size but, as might be expected, show some approach toward the larger form of the Temperate Zone. One agrees closely in color with *caucæ* and has the sides spotted, the other has but few spots on the sides and in color is therefore nearer the Temperate Zone bird. It can be exactly matched by specimens of *ochracea*! A specimen from Riobamba has the wing somewhat shorter than the average Temperate Zone bird but has the long tail and almost immaculate underparts of that form.

A specimen from the Junction of the Chanchan and Chiguancay Rivers (alt. 3000 ft.) is puzzling since it has the long tail of the Temperate Zone form and the sides are spotted as in *caucæ.*

Three males from Mt. Chimborazo and one from Quito have the large size and particularly long tail which characterize the Temperate Zone race.

One of the Mt. Chimborazo specimens is almost unspotted below. The others have a few small linear spots on the sides. It is evident therefore that there are two forms of *sparverius* in Ecuador, a smaller one with heavily spotted sides which inhabits the Tropical and Subtropical Zones, and a larger one with longer tail and with comparatively few spots on the sides which inhabits the Temperate Zone. The former is near the west Colombian race, the latter agrees in dimension with the type of *æquatorialis.*

The specimens collected by Rhoads at Huigra and at the junction of the Chanchan and Chiguancay Rivers indicate that these two forms intergrade. It is most unfortunate that in addition to being without a locality, the type of *æquatorialis* should be to some extent intermediate between these two Ecuadorian forms. It agrees with the Temperate Zone race in measurements, but in its spotted sides more nearly resembles *caucæ.* I have, however, already given reasons for the belief that to some extent these spots are due to immaturity, and it is my opinion that when mature the type of *æquatorialis* would not differ materially from Chimborazo specimens. I therefore adopt the name *æquatorialis* for the large Sparrow Hawk of the Temperate Zone of Ecuador and southward in Peru. Even should it prove to have the sides more spotted than our specimens indicate, and thus more closely approach *caucæ* in color, it may readily be distinguished from that form as well as from *ochracea* by its large size.

Specimens examined.— *Ecuador:* Quito, 1 ♂, 1 ♀; Mt. Chimborazo, 3 ♂♂; Riobamba, 1 ♂; Chunchi, 1 ♀; Ambato, 2 ♀♀; "Ecuador," 1 ♂ (type).

Cerchneis sparverius cinnamomina (*Swains.*).

Falco cinnamominus Swains., Anim. in Menag., 1837, p. 281 (Chile).

Char. subsp.— Very closely related to *C. s. australis* but male with the subterminal tail-band narrower, particularly on the outer rectrix, when it is sometimes obsolete; the tips of the central pair of rectrices rufous, the remaining rectrices more or less tipped with rufous; the outer rectrix less frequently with more than the subterminal bar.

Range.— Chile (and southern Peru? [1]).

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[1] Two males from Cuzco are intermediate between this form and *æquatorialis* but because of their rufous tail tips are in my opinion to be referred to the former rather than the latter; though it is by no means improbable that they may represent an undescribed race.

Remarks.— The characters here given are shown by six males from various localities in Chile on comparison with fourteen males from Chapada, Pernambuco, and San Paulo, Brazil. In only one of the Brazilian birds, an immature specimen from Chapada, Matto Grosso, is the tail appreciably tipped with rufous; nor do I find this character shown by other South American forms, except in *C. s. fernandensis* which is presumably an offshoot of *cinnamomina.* Five of the Chilean birds have only the subterminal bar on the outer rectrix. The sixth specimen has three bars on this feather. On the other hand, eleven of thirteen Brazilian birds have the outer rectrix with two or more bars, while only two have but the subterminal bar. Possibly this marking may here have a racial significance. It should be observed, however, that of twelve specimens of *fernandensis,* obviously an island representative of *cinnamomina,* five have the outer rectrix with only a subterminal band while seven have two or more bands on this feather.

Specimens examined.— *Chile:* Chile, 2 ♂♂, 1 ♀; Corral, 1 ♀; Santiago, 1 ♀; Valdivia, 1 ♂; Cautin, 1 ♂, 2 ♀♀; Ancud, 2 ♂♂.

Cerchneis sparverius fernandensis subsp. nov.

Char. subsp.— Similar to *C. s. cinnamomina* but more deeply colored and more heavily marked; ventral region and lower tail coverts clear buff; male with the upperparts darker, the black bars less sharply contrasted with the rufous interspaces, the underparts more heavily washed and with the spots larger and more numerous, those on the flanks being, in some specimens, broad black bars; female darker above, the black bars less sharply defined, the underparts (except throat) much deeper, in some specimens dull rufous obscurely streaked and spotted with blackish.

Type.— No. 2335, Brewster-Sanford Coll. ♂ ad. Juan Fernandez (Masatierra) Island, Jan. 14, 1914; R. H. Beck.

Range.— Island of Juan Fernandez, off Chile.

Remarks.— The Brewster-Sanford collection, which is on deposit in the American Museum, contains an excellent series of this strongly marked form collected by R. H. Beck. For comparison with this large series I have six males and five females of *cinnamomina* from Chile. The rufous at the tip of the rectrices, which is the chief distinguishing feature of *cinnamomina,* is present in a greater or less degree in *fernandensis.* As regards the markings of the outer rectrix, five males of *fernandensis* have only a subterminal bar on this feather while seven have two or more bars.

In the rich coloration, especially of the ventral region, and heavy markings of the underparts, the male of *fernandensis* is approached only by another insular form, *C. s. antillarum.* The females of these two races, however, represent the extremes in color of this sex, the latter being sharply streaked with black while the underparts of *fernandensis* are heavily washed with rufous, with darker, obscure shaft streaks. It thus bears some resemblance to three females of *ochracea* in juvenal plumage.

I have been permitted to name this interesting island race through the courtesy of Dr. L. C. Sanford and Mr. Frederick F. Brewster, whose collection contains the only specimens of it known to me.

Specimens examined.— Juan Fernandez, 12 ♂♂, 11 ♀♀.

Cerchneis sparverius australis (*Ridgw.*).

Falco gracilis (nec Lesson) Swains., Anim. in Menag., 1838, p. 281 (Bahia, Brazil).

Falco sparverius var. *australis* Ridgw., Hist. N. A. Birds, III, 1874, p. 166.

Char. subsp.— Adult male with the underparts largely white and more or less thickly marked with round black spots; the back and scapulars usually with broad, numerous black bars; average female paler below than in more northern forms. Closely resembling *C. s. cinnamomina* but male usually with no rufous in the tip of the tail.

Range.— From the eastern slopes of the Andes in Peru and Bolivia (and Argentina) eastward to the Atlantic (north to the Amazon?).

Remarks.— Assuming that Ridgway's name of *australis* was proposed as a substitute for *gracilis* of Swainson, preoccupied, Bahia is the type-locality of this race. Unfortunately two males from Pernambuco and one from San Paulo are the only specimens I have seen from the Brazilian coast. In color and markings of the underparts and back, practically the entire range of variation shown by the 16 males from the range I ascribe to this form is covered by these birds. In one Pernambuco specimen the outer pair of rectrices is lost; in the other these feathers are broadly barred with black from base to end. In the Rio Grande do Sul specimen the terminal half of this feather is barred. Two of Chapada specimens have the outer rectrix with two or more bars, while two have only the subterminal bar. Two or more bars appear therefore to be the more frequent marking among Brazilian specimens.

In size, as the appended table shows, there is much variation but apparently no constant or racial difference in dimensions. Birds from Chapada have the tail comparatively short but they are matched by Pernambuco specimens and exceeded in size by a male from San Paulo.

Of *Cerchneis s. peruana* Cory (Field Mus. Pub. 182, p. 296, Feb. 1915) I have seen only two males and a female from Macate, Peru, loaned me by Mr. Cory. These specimens can be matched in color and in size by birds in our series from Brazil, and I am unable therefore to separate them from the form to which I apply the name *australis*. One of the Macate males has the outer tail-feather with only the subterminal bar. In the other this feather is somewhat less than half grown, but the portion of the feather visible is whitish with three black bars.

Specimens examined.— *Brazil:* Pernambuco, 2 ♂♂; Rio Grande do Sul, 1 ♂, 1 ♀; Chapada, Matto Grosso, 11 ♂♂, 18 ♀♀. Bolivia: Yungas, 1 ♀. Peru: Macate, 2 ♂♂, 1 ♀.

Measurements of Males.

Name	Locality	Wing	Tail	Tarsus
C. s. isabellina	Maripa, E. Venez.	173.5	114	34
C. s. ochracea	Tachira, W. " (Type)	191	125	34
" " "	Villavicencio, Col.	188	126	37
" " "	Fusugasugá "	180	121	34
" " "	Honda "	169	113	35
" " "	" "	182	128	35.5
C. s. caucæ	Miraflores "	180	126.5	35
" " "	Palmira "	177.5	119	33
" " "	Cali "	176	122.5	34
" " "	La Florida "	183	125	34.5
" " "	Gualea, Ecuador	189	128	33
" " "	Huigra "	184	127	36
" " "	" "	187	129	37
C. s. æquatorialis	Quito "	197	137	37
" " " (Type)	"	197	137	38
" " "	(Mt. Chimborazo, 12000 ft.)	194	136	37
" " "	"	201.5	145	37.5
" " "	"	206	135	36
" " "	Riobamba	189	134	36
" " "	Chanchan and Chiguancay Rivers	194	134	37
C. s. cinnamomina	Valdivia, Chile	186	127	36.5
" " "	Cautin "	193	133.5	36.5
" " "	Ancud "	182	127	36.5
" " "	" "	191	131	36.5
" " "	" "	191	131	36.5
" " ?"	Cuzco, Peru	195	133	35
" " "	" "	188	133	35.5
C. s. australis	Macate, Peru	188	130	35
" " "	" "	183	134	35
" " "	Chapada, Brazil	185	126.5	34.5
" " "	" "	184	126	35
" " "	San Paulo "	198	133	36
" " "	Pernambuco "	173	120	35
" " "	" "	181	126	35
C. s. fernandensis	Juan Fernandez	192	132	36
" " "	"	190	134.5	34
" " "	"	190.5	133	36.5
" " "	"	185.5	128.5	35

Measurements of Females.

Name	Locality	Wing	Tail	Tarsus
C. s. isabellina,	Maripa, E. Venez.	183	125	33
" " "	" "	181.5	119	33
C. s. ochracea	Tachira, "	200	135	36
" " "	El Piñon, Col.	184	129	35
" " "	Honda "	196	136	35
C. s. caucæ	Laguneta "	194.5	132.5	36
" " "	Miraflores "	196	137.5	36
" " "	Palmira "	184	128	33
" " "	Popayan "	193	134	35.5
" " "	"Ecuador"[1]	195	129	38
" " "	Lima, Peru,	184	127	35
C. s. æquatorialis	near Quito, Ecuador	204	138	38
" " "	Ambato "	206	138	37.5
" " "	Chunchi "	208	148	39
C. s. cinnamomina	Corral, Chile	195.5	136.5	36
" " "	Santiago "	197	132	37
" " "	Cautin "	198.5	134	36
" " "	" "	194	129	35
" " "	Puno, Titicaca, Peru	210.5	148.5	37
" " "	" " "	212	149	39
" " "	" " "	198	132.5	37
" " "	Cuzco " "	200	143	36
C. s. australis	Macate, Peru	194	132	37
" " "	Chapada, Brazil	189.5	124.5	35.5
" " "	" "	199.5	132	35
" " "	" "	189	127	33
" " "	Rio Grande do Sul	192	122	34
C. s. fernandensis	Juan Fernandez	200	134	35.5
" " "	" "	203	140	36
" " "	" "	199	139.5	37
" " "	" "	203	142	35.5

Pyrrhura melanura pacifica subsp. nov.

Char. subsp.— Similar to *P. m. melanura* but smaller, the tail, relatively, much shorter; primary coverts not tipped with yellow; tail, above, redder; forehead, greener; bare orbital region blackish instead of whitish (in dried skins); bill less stout, mandible blacker.

Type.— No. 117615, Am. Mus. Nat. Hist., ♂ ad., Buenavista (alt. 1200 ft.), Nariño, southwestern Colombia, Sept. 28, 1912; W. B. Richardson.

Remarks.— Richardson obtained two males and a female of this species at Buena Vista and they appear to be the first specimens of the genus *Pyr-*

[1] Female "Type" of *æquatorialis.*

rhura to be recorded from the Pacific coast region in South America. In the shortness of their tails, as the appended measurements show, and the blackish skin of the orbital area, they differ from all their allies. Unfortunately I have no authentic specimens of *souancei* for comparison, but if that species is figured with even approximate correctness by its describer (Verreaux, Rev. et Mag., 1858, p. 437, pl. xii) it has the margins of the breast-feathers much wider and much whiter than in *pacifica.* In the proposed new race the markings of that area agree with those of a specimen of *melanura* from Pebas, Peru, but are somewhat more pronounced and slightly redder in tone. It should be stated, however, that in the Pebas skin the breast feathers are somewhat worn.

Measurements.

Name	Locality	Sex	Wing	Tail
P. m. pacifica	Buenavista, Col.	♂	123	101
" " "	" "	♂	122	92
" " "	" "	♀	123.5	95
P. m. melanura	Pebas, Peru	♂	127	119
P. souancei (*fide* Verreaux),	Napo, Ecuador		130	120
P. berlepschi,	Aplobamba, Bolivia	♀	134	145
P. rupicola	Yungas "		126	117

Psittacula conspicillata caucæ subsp. nov.

Char. subsp.— Similar to *P. c. conspicillata* Lafr., of the Bogotá region but larger, the wings and tail constantly longer, the bill averaging heavier, the blue areas of the rump, inner wing quills, upper and under wing-coverts decidedly less purple, spectrum-blue, rather than Hay's-blue or blue-violet in color.

Range.— Tropical Zone in the Cauca Valley ranging upward to the lower margin of the Subtropical Zone and westward over the San Antonio Pass to the arid basin of the upper Dagua Valley.

Type.— No. 107754, Am. Mus. Nat. Hist., ♂ ad., Cali (3500 ft.), Cauca Valley, Colombia, Dec. 21, 1910; W. B. Richardson.

Remarks.— This form is based on a series of twelve males and three females from the Cauca region, representing *caucæ,* and eleven males and six females, from the Magdalena Valley and Buena Vista, representing true *conspicillata.* The extremes in color are shown by three males from Caldas in the singular arid basin of the upper Dagua Valley, on the otherwise humid western slope of the Western Andes, and three from Puerto Berrio in the humid Tropical Zone of the Magdalena Valley, which have the rump, etc. hyacinth-blue, while their underparts are more glaucous less yellowish than other specimens from the Magdalena Valley.

Further south, in the more arid parts of the Magdalena Valley specimens are found which approach Cauca Valley birds in color but resemble in size the Puerto Berrio birds. A specimen from Buena Vista, near the eastern base of the Eastern Andes, resembles specimens from Honda at the western base of the range showing that this form occurs throughout the restricted Bogotá region.

Lafresnaye's description of the rump, etc. of *conspicillata* as "*pulcherrime indigotinis*" in connection with our knowledge of the sources whence Colombia birds skins were received in 1848, when he described this species, makes it more than probable that his type came from the Bogotá region and I therefore suggest Honda on the upper Magdalena River, at the foot of the trail to Bogotá, as an appropriate type-locality for *Psittacula conspicillata conspicillata.*

Measurements of Males.

	Locality	Wing	Tail
Psittacula conspicillata caucæ,	Caldas	82	39
" " "	"	79	40.5
" " "	San Antonio	80	40
" " "	Cali	83	43
" " "	"	81.5	43
" " "	"	82	44
" " "	Palmira	85	41
" " "	"	80	41
" " "	"	81	41
" " "	Rio Frio	83	43
Psittacula conspicillata conspicillata,	Chicoral	76	35
" " "	"	78	30
" " "	"	77.5	37
" " "	Honda	76.5	37.5
" " "	"	73.5	37
" " "	Puerto Berrio,	74.5	37.5
" " "	" "	75	36
" " "	Buena Vista	78.5	36.5

Curucujus massena australis subsp. nov.

Trogon massena Hellm. (nec Gould), P. Z. S., 1911, p. 1193 (Noanama, Col., ♂ ad.).

Char. subsp.— Similar to *C. m. massena* but smaller, male with the exposed upper surface of the inner rectrices bluish green, much as in *C. melanurus*, rather than a bronze green; female decidedly darker gray.

Type.— No. 117725, Am. Mus. Nat. Hist., ♂ ad., Barbacoas (sea-level), Colombia, Aug. 30, 1912. W. B. Richardson.

Remarks.— The occurrence of a form of *Curucujus* at Barbacoas extends the known range of this species southward from Noanama in western Colombia. From Noanama Hellmayr (*l. c.*) records an adult male which evidently belongs to the form I have here described, since he states that "compared with others from Central America, this bird is smaller, and has the middle pair of rectrices washed with dull bluish instead of bronze green." A female from Bagado, near Quibdo, further confirms the belief that *C. m. australis* is the form of this region. It agrees with a female from Barbacoas in color but has the tail considerably longer. The tail in the Barbacoas specimen, however, is so much shorter than the wing that it is difficult to believe the specimen is of normal size.

Unfortunately I have only one female from Barbacoas and this with the type and the Bagado female are all the specimens I have seen of the proposed new form. Of *C. m. massena* we have an excellent series taken from Mexico to Panama.

Measurements.

	Sex	Wing	Tail	Culmen	Width of rami
Barbacoas, Col.	♂	166	160	25	19
Panama R. R.	♂	162	160	27	22
San Rafael, Nic.	♂	168	167	26	20
Rio Coco "	♂	179	170	25.5	21
Oaxaca, Mex.	♂	176	173	26.5	22
Barbacoas, Col.	♀	154	133	24	19.5
Bagado "	♀	147	149	24	20
Gatun, Panama	♀	167	167	25	20
Matagalpa, Nic.	♀	170	168	25	21.5
Veragua "	♀	175	172	25	21
Talpaneca "	♀	178	176	25.5	21

Andigena nigrirostris occidentalis subsp. nov.

Char. subsp.— Similar to *A. n. spilorhynchus* (Gould) but with the red area at the base of the bill larger on the maxilla and crossing the base of the mandible.

Type.— No. 107922, Am. Mus. Nat. Hist., ♂ ad., San Antonio (alt. 6600 ft.), Western Andes, above Cali, Colombia, Jan. 8, 1911; W. B. Richardson.

Range.— Subtropical zone of the Western Andes of Colombia.

Remarks.— In this race, which is based on twelve specimens, chiefly from the type-locality, we have the extreme departure from the *nigrirostris* type of bill coloration, the first stage of which is marked by *A. n. spilorhynchus*. A specimen of the last-named form from Ecuador, has much less red at the base of the maxilla and none at all on the mandible. In describing *spilorhynchus* from eastern Ecuador, Gould (P. Z. S., 1858, p. 149) states that it differs from *nigrirostris* in having "obscure brownish red at the base of the upper mandible"; and Sclater (P. Z. S., 1858, p. 75) writes that Napo specimens "have an obsolete orange band at the base of the upper mandible, which extends rather more forward in front of the nostrils." Three specimens from the Central Andes, where singularly enough this species appears to inhabit the Temperate Zone, are evidently intermediate between *spilorhynchus* and *occidentalis* but are nearer the former. They have more red on the maxilla than in a specimen from Ecuador, but none or practically none on the mandible. It appears therefore that *A. n. nigrirostris* is restricted to the Eastern Andes and *occidentalis* to the Western Andes of Colombia, while *spilorhynchus,* an intermediate form, inhabits the Central Range and extends southward into Ecuador.

Chloronerpes rubiginosus buenavistæ subsp. nov.

Char. subsp.— Similar to *C. r. meridensis,* but upperparts and olive bars of underparts darker, cheeks grayer, bill longer; similar to *C. r. canipileus* (D'Orb.)[1] but with much more red and consequently darker, less golden in color. Similar to *C. r. alleni* (Bangs) but olive bars of underparts wider and yellowish ones narrower; tail always (?) unbarred; posterior underparts, especially lower tail-coverts, less distinctly barred.

Type.— No. 121768, Am. Mus. Nat. Hist., ♂, Buena Vista (above Villavicencio, 4500 ft.), Eastern Andes, Colombia, March 5, 1913; Geo. K. Cherrie.

Remarks.— The unbarred tail-feathers distinguish this bird from true *rubiginosus* and its nearer allies and indicates its closer relationships with *meridensis* and *canipileus* of which it is the obvious geographical representative. Of *buenavistæ* we have five specimens all from Buena Vista and the characters separating it from *meridensis* are based on comparison of these specimens with the type and five topotypes of the last-named form. Of *alleni* I have examined the type and topotype. Of *canipileus,* however, we have only a single authentic specimen; a female collected by Rusby at Reyes, Bolivia. This bird agrees with the Buena Vista specimens in size, but has the back less ruddy, more golden, as stated above.

Possibly a large series may show that the bird for which I have here proposed the name *buenavistæ* may not be separable from the Bolivian bird, but this seems improbable. In any event, the current reference of *canipileus* to *rubiginosus* is obviously incorrect since the Bolivian bird is a member of the group with unbarred rectrices. It should be added, however,

[1] *Picus canipileus* d'Orb. Voy. Am. Mer., IV, 1835–44, p. 379 (Chupé, Yungas, Bolivia).

that this character, while apparently reasonably constant in some forms is not so in others. Thus of nineteen specimens of *C. r. gularis* only two show traces of bars on the outer rectrices, but on the other hand ten out of eighteen specimens of *C. r. rubripileus* have these feathers barred. Of twelve specimens of *rubiginosus, trinitatis* and *tobagensis* not one is without bars. Six specimens of *meridensis* and four of *buenavistæ* are essentially unbarred, but of nine specimens of *alleni* seven are with bars. This form therefore seems to be, in respect to this marking, intermediate between the barred *rubiginosus* type and the unbarred Central American forms.

Measurements.

	Sex	Wing	Tail	Culmen
Merida, Venezuela	♂	121	68.5	24
" "	♂	122	74	24.5
Buena Vista, Col.	♂	125	77	28
" " "	♂	126	77	26
Merida, Venezuela	♀	123	75	23
" "	♀	120	70	23
Buena Vista, Col.	♀	124	74	28
" " "	♀	123	72	28

Atlapetes gutturalis brunnescens subsp. nov.

Char. subsp.— Similar to *A. g. gutturalis* but back, flanks and under tail-coverts browner, the former between olive-brown and fuscous rather than deep mouse-gray; the flanks and under tail-coverts buffy brown rather than mouse-gray; yellow of throat averaging paler and more restricted.

Type.— No. 77885, Am. Mus. Nat. Hist., ♂, Sept. 13, 1901, Boquete, Chiriqui, J. H. Batty.

Remarks.— Comparison of 35 specimens of this form (Boquete, Chiriqui, 26; San Jose, Costa Rica, 1; Irazu, Costa Rica, 1; San Rafael and Matagalpa, Nicaragua, 6; Guatemala, 1) with about an equal number from Colombia, including topotypical 'Bogotá' specimens show that the characters above given are constant and diagnostic. Specimens in fresh, postnuptial plumage are browner than those in worn breeding dress, but at any season Central American birds may be readily distinguished from Colombian ones.

There is a possibility that *Buarremon chrysopogon* Scl. ex Bp. MS., said to have come from "California" may be applicable to the Central American form but in the absence of means of determining whence it came, there appears to be no way of deciding whether or not it is synonymous with the

Central American form. The type which Sclater (P. Z. S., 1856, p. 86) examined in the Paris Museum, in 1856, is doubtless now too faded to be certainly identified with either form. Sclater, however, remarks that it resembles *A. albinucha,* except for the color of the underparts, when it may be of significance to observe that *albinucha* resembles *gutturalis* rather than *brunnescens* in the color of the back.

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Article XII.— SOME ADDITIONS TO THE NORTH AMERICAN ANT-FAUNA.[1]

By William Morton Wheeler, Ph.D.

Family FORMICIDAE.

Subfamily Ponerinæ.

1. **Stigmatomma pallipes arizonense** subsp. nov.

Worker. Length nearly 4 mm.

Differing from the worker of the typical form in its somewhat smaller size, in having the head narrower in front so that the sides are nearly parallel, in the feebler development of the teeth at the anterior corners of the head and in sculpture, pubescence and coloration. The punctuation of the head and thorax is finer and denser so that these parts are distinctly more opaque than in the typical form, the pubescence is shorter and seems to be lacking on the upper surface of the head, and the whole body is dull ferruginous, with scarcely paler legs, whereas in the typical *pallipes* the head, thorax and petiole are usually blackish in mature specimens and the legs, mandibles and antennæ are testaceous.

Described from a single worker taken by Mr. W. M. Mann in Ramsay Cañon, Huachuca Mountains, Arizona, at an altitude of 5800 ft.

2. **Stigmatomma pallipes oregonense** subsp. nov.

Worker. Slightly larger than the typical *pallipes;* head somewhat shorter; antennal scapes longer, so that their reflected tips reach the lateral margin of the head two-thirds the distance from the anterior to the posterior corners; eyes distinctly larger; teeth on the anterior border of the clypeus smaller and more numerous (9 to 10). Petiole from above as broad as long, with convex sides. In the typical form it is distinctly longer than broad, with rather straight, subparallel sides. Sculpture, pilosity and color as in the type.

Female (deälated). Closely resembling the worker; eyes much larger than in the typical *pallipes*.

Described from eight workers taken at Marion, Oregon, by Rev. P. J. Schmitt O. S. B., and four females and five workers taken by Mr. Trevor Kincaid at Olympia, Washington.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 88.

3. **Proceratium silaceum rugulosum** subsp. nov.

Worker. Body more heavily rugulose and therefore more opaque than in the typical form and darker and more brownish in color.

Female. (deälated.) Closely resembling the worker and differing from the female of the typical form in the same particulars.

Described from a single female and four workers taken by Mr. Wm. Blatchley at Wyandotte, Indiana. The specimens have been compared with four cotypes of *silaceum* collected by Rev. P. J. Schmitt at Beatty, Pennsylvania.

4. **Ectatomma (Parectatomma) hartmani** sp. nov.

Worker. Length nearly 3 mm.

Head distinctly longer than broad, subrectangular, with rounded posterior corners, convex above, a little broader behind than in front, with rather straight sides and feebly excavated posterior margin. Eyes a little behind the middle of the sides of the head. Clypeus short, rather convex, with its anterior border straight and entire in the middle. Mandibles rather long, distinctly triangular, the apical margin longer than the basal, not denticulate, meeting the basal margin at an obtuse angle which is neither membranous nor translucent. Antennæ moderately robust; scapes reaching nearly to the posterior corners of the head; first funicular joint as long as the two succeeding joints together; second joint as long as broad; remaining joints, except the last, broader than long. Thorax above feebly convex, slightly transversely impressed between the pro- and mesonotum, but without a suture; base and declivity of epinotum subequal, the latter concave and sloping, on each side above with a small protuberance but neither dentate nor tuberculate. Petiole shorter than high, convex and rounded dorsally, a little broader than long, its ventral surface with a blunt, compressed projection directed downward and forward. First gastric segment narrower and a little longer than the second, with a small, truncated tubercle on its anteroventral surface. Legs rather long; hind coxæ spined.

Somewhat shining, especially the mandibles, which are covered with shallow foveolæ and striated at the base. Clypeus, frontal area, head, thorax, including the epinotal declivity, and the gaster rather finely and regularly, longitudinally rugose. Antennal scapes and legs with minute, scattered, piligerous punctures.

Hairs white, erect, coarse, long and abundant, covering the body, legs and antennal scapes; funiculi with shorter, suberect hairs.

Body, mandibles and antennæ ferruginous red; legs somewhat paler and more yellowish.

Described from a single specimen taken by Mr. Carl Hartman at Huntsville, Texas. This is the first species of *Ectatomma* to be taken within the boundaries of the United States. Though similar in color and structure to the three known species of the subgenus *Parectatomma* (*rastratum* Mayr of Brazil and Costa Rica, *triangulare* Mayr of Uruguay and Argentina, and *trigona* Emery of Brazil) it is much smaller. In the structure of the mandibles it is intermediate between these species and those of the subgenus *Guamptogenys* Mayr.

5. **Odontomachus hæmatoda coninodis** subsp. nov.

Worker. Length 6–8 mm.

Related to the subsp. *clarus* Roger, but the head is narrower and the body averaging smaller. The petiolar node is conical and convex behind and not acuminate at the tip or produced into a spine as in the typical *hæmatoda* and the subsp. *insularis* Guérin. The head, thorax, petiole and appendages are even paler and more yellowish than in *clarus* and the gaster is brown or dark red, with pale tip and segmental margins. The sculpture of the head and thorax is finer than in *clarus* and the surface a little more shining.

Female. Length 8–9 mm.

Resembling the worker and having the petiole of the same shape, but the sculpture and color of the female *clarus*, the gaster being blackish and the remainder of the body more reddish than in the worker. Wings grayish hyaline, with yellowish veins and stigma.

Described from one deälated female and seventeen workers taken Nov. 12–14 by myself in Hunter and Miller Cañons, Huachuca Mts., Arizona, at altitudes varying from 5000–7000 ft., and a single winged female taken during August by Mr. W. M. Mann in Ramsay Cañon, in the same mountain range. This subspecies, which forms small colonies and nests under stones, may be regarded as a depauperate desert mountain form derived from the subspecies *clarus*.

6. **Odontomachus hæmatoda desertorum** subsp. nov.

Worker. Length 9–10 mm.

Larger and more robust than the subsp. *clarus*, the head and thorax more coarsely sculptured and decidedly more opaque, the whole body, except the gaster, of a deeper, richer red, the mandibles, antennæ and legs scarcely paler, the gaster black, shining. The petiole differs in shape from that of the preceding subspecies and from *clarus* in having a rather long, gradually tapering and backwardly directed point. In profile both the anterior and posterior surfaces of the node, except very near its tip, are feebly convex. Pilosity and pubescence as in *clarus*.

Described from nine workers taken in the dry arroyo back of the Carnegie Desert Laboratory, near Tucson, Arizona. They were running over the dry soil. I did not succeed in finding the nest.

Subfamily Dorylinæ.

7. **Eciton (Acamatus) leonardi** sp. nov.

Worker. Length 2–3 mm.

Head distinctly longer than broad, slightly broader in front than behind, with feebly convex sides and feebly excised posterior border. Eyes absent. Mandibles with 4 teeth, a prominent one at the tip and one at the base of the apical border and two smaller ones near the tip and separated by a concave diastema from the basal tooth. Antennal scapes slender at the base, but rapidly enlarging towards their tips, less than half as long as the head; funiculus not enlarged distally, joints 2–6 slightly broader than long, remaining joints at least as long as broad. Thorax less than $\frac{2}{3}$ as broad and about as long as the head including the mandibles, slightly broader anteriorly, with distinct mesoëpinotal and, in the large worker, very feebly indicated promesonotal suture, and slightly constricted at the former. Pronotum without a transverse anterior carina, about twice as long as the epinotum, in profile feebly rounded dorsally and a little higher than the epinotum; base and declivity of the latter subequal, the base with a somewhat triangular impression in the middle line at its anterior border. Petiole from above rectangular, about $\frac{1}{4}$ longer than broad, with straight, subparallel sides, in profile convex and evenly rounded above, its ventral surface slightly concave and with a small blunt tooth anteriorly. Postpetiole broader than long, distinctly broader than the petiole, a little broader behind than in front, with straight anterior and posterior borders and rounded sides. In profile this segment appears much shorter than high and has a distinct tooth at its antero-ventral border. Gaster oval, pointed, somewhat larger than the head. Legs rather short and slender; tarsi with simple claws.

Shining: mandibles rather coarsely striatopunctate; head and prothorax covered with sparse, rather coarse, piligerous punctures; on the remainder of the body these punctures are finer and much less conspicuous. Impression at base of epinotum slightly opaque and transversely shagreened.

Hairs pale yellow, only moderately long and abundant, erect or suberect on the body, legs and scapes; shorter on the funiculi; pubescence very sparse but rather long, visible on the gaster and posterior portion of the head.

Reddish yellow; clypeal region and mandibles red, the teeth of the latter black.

Described from three workers taken by Mr. Percy Leonard on Point Loma near San Diego, California. This species belongs to the group of small Ecitons including *E. californicum* Mayr, *nitens* Mayr, *commutatum* Emery, *pauxillum* Wheeler and *angustinode* Emery. From *pauxillum* it is readily distinguished by its greater size, the shape of the head, mandibles and pedicel; from *angustinode* by the greater size, much broader pedicel, more slender antennæ, shining epinotum, etc.; from *californicum* by the shape of the head, mandibles and pedicel, shorter thorax and different sculpture; from *nitens* by its smaller size and the absence of a pronotal carina, the shape of the mandibles, etc.; from *commutatum* by the shape of the mandibles, more slender antennæ and much feebler mesoëpinotal suture.

Subfamily Myrmicinæ.

8. **Cardiocondyla emeryi** *Forel.*

A single worker of this species, which has not before been recorded from the United States, was sent me by the American Museum of Natural History from Miami, Florida. The species is widely distributed in the West Indies (St. Thomas, St. Vincent, Bahamas, Cuba, Porto Rico, Jamaica) and in several localities in the Old World tropics (Palestine, India, Madagascar, Polynesia).

9. **Solenopsis picta** Emery var. **moerens** var. nov.

Worker. Differing from the type of the species from Florida only in color, the whole body being uniform piceous brown, the mandibles, antennæ and legs brownish yellow.

Six workers taken by Mr. J. D. Mitchell from a dead pecan twig at Victoria, Texas.

10. **Solenopsis huachucana** sp. nov.

Worker. Length 1.5–2 mm.

Head subrectangular, distinctly longer than broad, a little broader in front than behind, with rounded posterior corners and nearly straight posterior and lateral borders. Eyes large, convex, with 6–8 facets in their greatest longitudinal diameter. Clypeus prominent, with strong median carinæ terminating at the anterior margin in two large, acute teeth; lateral teeth small and blunt, indistinct in some specimens. Mandibles with oblique 4-toothed apical margins. Antennæ slender, scapes reaching $\frac{2}{3}$ the distance from the eyes to the posterior corners of the head, club not longer than the remainder of the funiculus, but much broader, its basal fully half as long as its terminal joint; first and second joints much longer than broad, joints 3–8 fully as long as broad, at least in large individuals. Thorax through the pronotum a little more than half as broad as the head; in profile the dorsal outline of the pronotum is convex in front and straight and sloping behind to the short but pronounced mesoëpinotal constriction; epinotum with the base longer than the declivity, the former convex in profile, the latter sloping and concave, the angle between the two surfaces obtuse and much rounded. Petiole with a very short, narrow peduncle, the node slightly broader than long; postpetiole slightly lower and broader, nearly spherical above, a little broader than long; neither petiole nor postpetiole with a distinct tooth on the ventral side. Gaster elliptical, its anterior border concave in the middle.

Smooth and shining throughout, with very sparse and indistinct piligerous punctures on the body and legs.

Hairs whitish, bristly, of unequal length, erect on the body and moderately abundant, shorter on the antennal scapes and legs.

Yellow; posterodorsal portion of head and posterior half of gaster infuscated; some specimens also with the thorax slightly fuscous. Mandibular teeth black.

Female (deälated). Length 5.5 mm.

Head as long as broad, subrectangular, with rather convex sides and feebly excised posterior border. Eyes convex, nearly $\frac{2}{5}$ as long as the sides of the head. Antennal scapes not reaching half way between the posterior border of the eyes and the corners of the head. Mandibles with only 3 teeth. Lateral clypeal teeth obsolete. Thorax elongate elliptical, nearly three times as long as broad; epinotum rounded and sloping, without distinct base and declivity. Petiole not distinctly pedunculate, node high, compressed anteroposteriorly, its anterior slope concave in profile and rapidly rising to the rather acute summit, the posterior slope straight and abrupt. Postpetiole short, transversely elliptical, but little broader than the petiole.

Surface shining and very sparsely and minutely punctate as in the worker; erect hairs more abundant and more yellowish. Color of body rich yellowish testaceous, with a broad band across the posterior portion of the first gastric segment and the basal portions of the succeeding segments dark brown; mandibles and clypeus red.

Described from two females and numerous workers taken from two nests under stones in Miller Cañon, Huachuca Mts., Arizona, at an altitude of about 5500 ft. This species is readily distinguished in the worker phase from all the described forms of *Solenopsis* from the United States, except those of the *geminata* group, by its much larger eyes. There is a slight but distinct tendency to polymorphism in the worker adumbrating the condition seen in *geminata* Fabr. and *wasmanni* Emery.

11. **Solenopsis aurea amblychila** subsp. nov.

Worker. Differing from the typical *aurea* Wheeler in having the two carinæ terminating bluntly behind or at the anterior border of the clypeus and not projecting beyond the border as two acute teeth, in having the funicular joints 2–7 distinctly longer and in the mesoëpinotal suture, which, though as deeply impressed as in *aurea*, is more acute, i. e., not so broad at the bottom. The profile outline of the thorax is therefore different, the base of the epinotum and the posterior surface of the epinotum being more nearly straight in *aurea* and more rounded in the new subspecies.

Female. Differs from that of *aurea* in the same clypeal characters as the worker.

Male. Indistinguishable by any satisfactory characters from the male of *aurea.*

Described from many specimens taken from populous colonies nesting under large stones in the Huachuca Mts., Arizona (Ramsay Cañon 4800 ft.; Hunter's Cañon 5500 ft.; Carr Cañon 6000 ft.; Miller Cañon 5000–5400 ft.). I have also received a series of workers, males and females, from Guadalajara, Mexico, taken by Mr. J. F. McClendon.

12. **Solenopsis geminata sævissima** *F. Smith.*

In a recent revision of the *Solenopsis* species of the *geminata* group, Forel has made the important discovery that one of the forms generally attributed to this species lacks the large soldier phase, so that the worker caste is much less polymorphic. This form he originally described as the subsp. *pylades* from a female taken in Mexico, and to it he later referred workers from Colombia, Amazonas, Parà, São Paolo, Argentina, etc. I have recently revised the large amount of *geminata* material in my collection, and, although I am able to recognize most of the forms cited by Forel, I find myself unable to accept his interpretation and the name *pylades*. Forel is undoubtedly right in regarding this as a distinct form, but it is equally certain that it had been previously described by Fred. Smith under the name *sævissima*. In the first place, Smith's description is unusually good and applies perfectly to the typical yellow *pylades*. In the second place, his specimens were received from Bates, who gives an interesting account of the habits of this "fire ant" in Brazil. Moreover, Mr. W. M. Mann, who collected extensively in the region where Bates secured his specimens and made his observations, tells me that it is there the only common and widely distributed *Solenopsis*, and the numerous specimens collected by Mr. Mann prove to be typical *pylades* Forel. I believe I am justified, therefore, in resuscitating Smith's *sævissima* and in relegating *pylades* to the synonymy, but owing to the existence in the United States of the two following forms, which are clearly intermediate between *sævissima* and *geminata*, I am unable to regard the former as anything more than a subspecies of the latter.

13. **Solenopsis geminata xyloni** *MacCook.*

This form is widely distributed in Texas and is probably the same as the ant described by Buckley as *Myrmica sabeana*. The worker measures 2–5.5 mm. in length. The largest specimens are shaped like moderately large *geminata* workers, with rectangular head and the tips of the antennal scapes reaching on the sides of the head half way between the eyes and the posterior corners, but the surface of the head is much smoother and the scattered punctures much smaller, though larger and more conspicuous than in *sævissima*. The mandibles are not abruptly curved as in the largest workers of the true *geminata*. The color is variable, being in some of the largest workers deep red, with the posterior half of the gaster black, in others the body is blackish red, with the mandibles and the anterior half or two thirds of the head light red, the legs dark red or with the femora infuscated. Small workers are black or very dark red, with the anterior part of the head paler.

The female measures 6–7 mm. The head is intermediate in size and shape between that of the female *sævissima* and *geminata,* the antennal scapes are also intermediate in length and the punctures on its upper surface are smaller than in *geminata* but more distinct than in *sævissima.* The mandibles have the same curvature as in the latter form. The coloration is that of the largest workers.

In the male the head is more opaque and punctate, as in the true *geminata,* and not so smooth as in *sævissima,* and the thorax has three broad, longitudinal red stripes.

I have seen large series of this ant from many localities in Central and Western Texas (Austin, Fort Davis, etc.), from Arizona (Phœnix, Huachuca Mts.) and Mexico (Guadalajara).

14. **Solenopsis geminata maniosa** subsp. nov.

Smaller than the other forms of *geminata* in all three phases, the worker measuring only 1.8–4.5 mm., the female 5–6 mm., the male 4–5 mm. The head of the largest worker is less rectangular and more rounded, owing to its distinctly more convex sides, the color is a rich light reddish yellow, with the posterior half of the gaster black and the borders of the gastric segments yellowish. The head, thorax and pedicel of the smallest workers are scarcely darker, with nearly the whole of the gaster black or dark brown.

In the female the head is rather rectangular, with straight posterior border, the mandibles are gradually curved, the antennal scapes reaching nearly to the posterior corners. The color is rich yellowish red, the mesonotum, except its middle line and the scutellum, brownish. In some specimens the whole gaster is black, with only the extreme base red, in others it is red with a broad black band across each segment. These bands are sometimes connected by a longitudinal middorsal stripe of the same color.

This is the common and perhaps the only form of *geminata* in Southern California. I have taken it in large colonies under stones and in diffuse and irregular crater nests in dry deserts and arroyos in the following localities; San Ysidro, near Santa Barbara (type locality), Pasadena, Claremont, La Jolla, San Diego, and Needles, and have received specimens from Los Gatos, Mt. Diablo Range (J. C. Bradley), Whittier (H. L. Quayle), Visalia (Culbertson), Jacinto Barranca, Fresno County (J. C. Bradley), Eaton's Cañon, Los Angeles County, Fresno, Brookdale and Friant (R. V. Chamberlin). I have also met with it in Arizona (Tucson, Tempe, Benson) and have received specimens from Thatcher (R. V. Chamberlin) in the same state, from Alamito, New Mexico (G. von Krokow) and Ojos del Diablo, in Chihuahua, Mexico (C. H. Tyler Townsend).

As a result of the study of my material I submit the following arrangement of the species, subspecies and varieties of *Solenopsis* of the *geminata* group:

1. *Solenopsis geminata* Fabricius
   - var. *diabola* Wheeler
   - var. *nigra* Forel
   - subsp. *medusa* Mann subsp. nov. (in MS.)
   - subsp. *rufa* Jerdon
     - var. *micans* Stitz.
   - subsp. *xyloni* MacCook
   - subsp. *maniosa* subsp. nov.
   - subsp. *sævissima* F. Smith (= *pylades* Forel)
     - var. *richteri* Forel
     - var. *incrassata* Forel
     - var. *tricuspis* Forel
     - var. *quinquecuspis* Forel
   - subsp. *electra* Forel.
2. *Solenopsis aurea* Wheeler
   - subsp. *amblychila* subsp. nov.
3. *Solenopsis gayi* Spinola.

15. **Pheidole longipes** *Pergande.*

This interesting species was originally described by Pergande from Lower California as a race (subspecies) of *Ph. susannæ* Forel, and is evidently the form mentioned as a variety of this ant by Emery in his "Beiträge" (p. 297) as occurring in California. I possess a worker cotype from the Pergande collection and also a worker from Emery taken at San Jacinto, Cala. Forel has shown that *longipes* is an independent species quite distinct from *susannæ*. During the winter of 1910 I found *longipes* in several localities in the vicinity of San Diego, California, especially at La Jolla and Lakeside. It makes rather large mound-nests not unlike those of *Ph. morrisi* Forel in the South Atlantic States. The female (deälated), which has not been described, measures nearly 6 mm. and is of a deeper ferruginous red color than the soldier, with paler and more yellowish legs. The whole body, including the gaster, is opaque, with only the borders of the mandibles and frontal area shining. The epinotum has a broad median impression and bears a pair of moderately large spines, which are laterally compressed and fully as long as broad at their bases; the postpetiole is nearly twice as broad as long, with bluntly conulate lateral borders. The pubescence is sparse but distinct, especially on the gaster. The surface of the thorax is densely rugulose-punctate, the pedicel and gaster densely and finely punctate, with larger, sparser piligerous punctures. The scuplture of the head resembles that of the soldier but is much coarser and the longitudinal rugæ are longer and more prominent. In the worker the epinotal spines are distinctly longer than in the cotype from Lower California, and additional material from this locality may show that the Californian form is a distinct variety.

16. **Pheidole militicida** sp. nov.

Soldier. Length 8 mm.

Head large, subcordate, scarcely longer than broad, distinctly broader behind than in front, with very deeply and angularly excised posterior border, in profile moderately convex above and below, the greatest depth being in the middle; cheeks slightly concave; eyes small, about $\frac{1}{4}$ the length of the head from the anterior corners. Occipital furrow deep. Mandibles very convex, bluntly bidentate at their tips. Clypeus short, flat, ecarinate, its anterior border distinctly notched in the middle. Frontal area elongate, deep, triangular, smooth, without a median carinula. Frontal carinæ short, strongly diverging. Antennæ small, slender; scapes much curved but not flattened at the base, reaching only as far as the eyes, joints 2–8 of the funiculus slightly longer than broad, club shorter than the remainder of the funiculus, its two basal joints subequal, together a little longer than the terminal joint. Thorax robust, with rather prominent, rounded humeri, the distance between which is less than half the width of the head; pro- and mesonotum forming together a subspherical mass in profile, the mesonotum being without a transverse constriction or torus. Mesoëpinotal constriction very deep. Epinotum short and high, its base in profile convex and passing into the sloping concave and somewhat longer declivity without a distinct boundary; spines stout, blunt, half as long as the distance between their bases, with slightly recurved tips, directed upward and somewhat outward and backward. Petiole from above but slightly longer than broad, with short, indistinct peduncle, broadest through the node, which is transverse, much compressed anteroposteriorly, with sharp, broadly excised border. Postpetiole somewhat less than twice as broad as the petiole, nearly twice as broad as long, forming above a low, anteroposteriorly compressed node, its sides produced in the middle as distinct conules. Gaster somewhat smaller than the head, flattened, broadly elliptical. Legs rather long and slender.

Shining; mandibles and posterior $\frac{2}{3}$ of head sparsely and rather finely punctate; sides of clypeus and anterior third of head sharply and rather finely longitudinally rugose, the rugæ between the frontal carinæ diverging posteriorly, those on the cheeks separated by punctate spaces. Base of epinotum transversely, its sides irregularly rugulose; anterior surface of postpetiolar node with a series of short, parallel grooves. Gaster and legs with scattered, piligerous punctures.

Hairs rather short, golden yellow, abundant, erect or suberect, covering the whole body, scapes and legs.

Reddish testaceous; gaster and legs yellow; borders of mandibles, anterior border of head and occipital groove black.

Worker. Length 3–3.5 mm.

Head subrectangular, as broad as long, with nearly straight posterior border and very feebly convex sides, with the eyes just in front of the middle. Mandibles with oblique blades furnished with two large apical and several smaller basal teeth. Clypeus convex, with entire, rounded anterior border. Antennæ similar to those of the soldier, but with the scapes extending a little beyond the posterior corners of the head. Thorax differing from that of the soldier in being more slender, with the mesonotum and base of epinotum long and rather straight in profile and the spines reduced to minute, erect teeth. Petiolar node compressed, sharp and transverse as in the soldier, but the border, seen from behind, is straight and entire. Postpetiole about twice as broad as the petiole, rounded in front above, without lateral conules, the sides rather straight behind, in profile feebly convex above. Gaster a little smaller than the head.

Shining; mandibles somewhat opaque; their bases and the cheeks longitudinally rugulose and punctate; sides of meso- and epinotum irregularly rugulose-punctate.

Hairs white, long, of unequal length, moderately abundant, erect on the body, on the legs and scapes shorter and more oblique.

Black; mandibles brownish yellow, with black teeth; clypeus, antennæ, tarsi, funiculi, articulations of legs and posterior borders of gastric segments brown.

Described from several soldiers and workers taken from a number of colonies in the desert at Hereford and Benson (alt. 3600 ft.), in Southern Arizona. This species is very closely related to *Ph. macclendoni* Wheeler, but both the soldier and worker are larger, the former is monomorphic, has the frontal area distinct and the rugosity not extending so far back on the head and the petiole and postpetiole are of a different shape when seen from above, the latter being larger, rounded above and with blunter sides, the thorax is more extensively sculptured, etc. The workers of the two species are more similar, but besides the difference in size, that of *macclendoni* is brown, with darker head and gaster.

The nests of *Ph. militicida* are small craters, 3–5 inches in diameter. When I found them at Hereford and Benson during November 1910, they were covered with masses of chaff, showing that the ant is a true harvester. Only workers could be obtained by the most diligent excavation of the nests, but among the chaff on nearly all the craters the workers had deposited numerous heads and dismembered bodies of soldiers. Mr. W. M. Mann, who collected at Hereford during August took living soldiers in the nests and from his specimens the foregoing description of the soldier is drawn. It appears, therefore, that all the individuals of this caste are regularly killed off by the workers on the approach of winter, probably after they have broken open all the hard seeds collected by the workers. Such a slaughter of the members of a large caste during a season when their activities are no longer required, when they would simply be a burden on the colony by consuming stored food and when fresh food cannot be collected, must have great advantages. Although I have never noticed this behavior in other species of *Pheidole,* I believe that a study of the harvesting species with very large-headed soldiers in the deserts of the southwest may bring other similar cases to light.

17. **Pheidole spadonia** sp. nov.

Soldier. Length 4–4.5 mm.

Head very large, subrectangular, $1\frac{1}{3}$ times as long as broad, distinctly broader in front than behind, with straight sides and rounded posterior lobes, separated by a deep occipital excision, which is continued forward as a pronounced occipital groove to the middle of the head. In profile it is most convex in the middle and distinctly compressed dorso-ventrally behind. Eyes rather small, flattened, at the anterior fourth of the sides. Mandibles very convex, with two large apical and one or two small basal teeth. Clypeus very short, its anterior margin broadly excised in the middle, its central portion feebly convex but not carinate. Frontal area triangular, rather deep. Frontal carinæ short, diverging. Antennæ very small and slender, the scapes curved but not flattened at the base, not reaching to the eyes; funicular joints 2–8 distinctly longer than broad; club shorter than the remainder of the funiculus, its two basal joints subequal, together as long as the terminal joint. Thorax short, robust, through the prominent humeri not more than half as broad as the head. In profile the pronotum is rather straight and sloping, forming a blunt obtuse angle with the mesonotum, which is of the same length and slopes backward at a slighter inclination but terminates near the mesoëpinotal suture in a sharp, narrow, transverse torus with abrupt, concave posterior slope. Epinotum with subequal base and declivity, the latter sloping, concave; spines rather slender and pointed, as long as broad at their laterally compressed bases, twice as far apart as long, directed upward and outward. Petiole from above with extremely short peduncle, subrectangular, as broad in front as behind, with sharp anterior angles; in profile the node has a long concave anterior and abrupt, straight posterior surface, its border is transverse, rather sharp and feebly excised in the middle. Postpetiole nearly 3 times as broad as the petiole and four times as broad as long, its sides produced as prominent pointed projections with convex anterior and concave posterior borders. Gaster broadly elliptical, much smaller than the head, somewhat flattened dorso-ventrally. Legs rather long, with stout femora.

Shining; mandibles smooth, with sparse and very small piligerous punctures; clypeus smooth and shining in the middle, longitudinally rugulose on the sides; anterior half of head very sharply, longitudinally rugulose, the rugæ on the front distinctly diverging, those on the cheeks parallel. Posterior half of head, pro- and mesonotum smooth and shining, with very small, scattered piligerous punctures; metanotum feebly and indistinctly rugulose-punctate, the declivity of the epinotum between the spines finely transversely rugulose. Petiole and postpetiole with fine, dense, shallow punctures on the sides so that these parts appear a little more opaque. Gaster smooth and shining, with fine, scattered, piligerous punctures.

Hairs golden yellow, coarse, of unequal length, rather long and abundant, suberect; longer and more reclinate on the gaster, shorter and oblique on the legs and scapes.

Testaceous yellow; legs a little paler; mandibles and clypeus deep red, with black borders; petiole and postpetiole brownish, gaster also faintly tinged with brown.

Worker. Length: 1.5 mm.

Head as broad as long, subrectangular, with feebly convex sides and feebly excised posterior border; anterior clypeal margin entire, broadly rounded. Antennal scapes reaching a little beyond the posterior corners. Pro- and mesonotum together convex and evenly rounded above, the latter without a torus. Base of epinotum feebly convex, longer than the declivity; spines reduced to small, slender, erect teeth. Petiole from above twice as long as broad, with concave sides; node rounded, entire; postpetiole about $\frac{1}{3}$ again as broad as the petiole, convex and rounded above, transversely elliptical, distinctly broader than long. Gaster about the size of the head.

Smooth and shining; mandibles finely striato-punctate; cheeks longitudinally rugulose. Mesopleuræ, epinotum and petiole slightly opaque, densely punctate.

Pilosity similar to that of the soldier, but hairs on the body more obtuse. Color like that of the soldier but the head and thorax more brownish; mandibles and clypeus not darker than the anterior portion of the head; legs and antennæ yellowish.

Described from six soldiers and nineteen workers taken on the banks of the Santa Cruz River at Tucson, Arizona. The nests were incomplete craters in sandy soil exposed to the sun, with small entrance and the excavated sand dumped to one side. Only one or two soldiers were found in a nest. The species is apparently carnivorous.

This ant at first sight seems to be very closely related to the South American *Ph. stulta,* but the soldier is at once distinguished by the absence of a carina on the clypeus and considerable differences in the shape of the petiole and postpetiole. The worker is much smaller than that of *stulta,* with much shorter antennal scapes, longer epinotal spines, shorter thorax, etc.

18. **Pheidole virago** sp. nov.

Soldier. Length 4–4.5 mm.

Head very large, about $\frac{1}{4}$ longer than broad, distinctly broader behind than in front, with straight sides, and prominent, rounded posterior lobes, separated by a very deep occipital excision continued forward nearly to the frontal area as a deep groove. In profile the head is convex above and below and very slightly compressed in the region of the posterior lobes. Eyes rather small and flat, near the anterior fourth of the head. Mandibles very convex, with two blunt apical teeth. Clypeus very short, its anterior border feebly and sinuately excised in the middle, median surface feebly convex, with indistinct carina. Frontal area distinct, broadly triangular. Frontal carinæ short, diverging. Antennæ small and slender; scapes curved, but not flattened at the base, not reaching to the eyes; funicular joints 2–8 subequal, a little longer than broad; club shorter than the remainder of the funiculus, the two basal joints subequal, together a little longer than the terminal joint. Thorax very short and robust, narrower through the prominent but rounded humeral angles than half the head; pronotal surface in profile slightly convex, sloping anteriorly; mesonotum straight and sloping backward, with a distinct but blunt torus near its posterior margin; epinotum as broad as long; base and declivity in profile subequal, the latter sloping; spines stout, blunt, half as long as the base and half as long as their distance apart at the base, directed upward and slightly outward and backward. Petiole from above with very short peduncle, $1\frac{1}{2}$ times as long as broad, somewhat broader behind through the node, which is transverse, with long, concave anterior and short, abrupt posterior declivity, the border rather sharp and distinctly excised in the middle. Postpetiole more than twice as broad as the petiole and nearly 3 times as broad as long, its sides produced as blunt points with convex anterior and concave posterior borders. Gaster much smaller than the head, broadly elliptical and somewhat flattened. Legs long, with moderately thickened femora.

Shining; mandibles with a few coarse punctures near the apical borders and smaller, scattered punctures on the remaining surface. Clypeus longitudinally rugulose even in the middle. Anterior $\frac{2}{3}$ of head with rather sharp, fine longitudinal rugæ, those on the front diverging; posterior third smooth, with much scattered, coarse and rather elongated punctures. Pro- and mesonotum transversely, mesopleuræ and sides of epinotum longitudinally rugulose; concave declivity of epinotum between the spines indistinctly and finely transversely rugulose. Petiole and postpetiole slightly opaque, upper surface of latter with a row of large, elongate, piligerous punctures. Gaster shining, minutely shagreened and with scattered piligerous punctures.

Hairs yellow, rather coarse, suberect, of unequal length, moderately abundant, scarcely longer on the gaster than on the head; shorter and somewhat more oblique on the legs and antennal scapes.

Head yellowish red; mandibles dark red, their borders and the sides and anterior border of the clypeus blackish; thorax and pedicel brown, the postpetiole darker; gaster black, with brown posterior borders to the segments; legs brownish yellow; antennæ scarcely paler than the head.

Worker. Length: 1.5 mm.

Head a little longer than broad, subrectangular, with feebly convex sides and straight posterior border, feebly notched in the middle. Anterior border of clypeus entire, broadly rounded. Antennal scapes reaching a little beyond the posterior corners of the head. Thorax broad through the pronotum, with rather prominent humeri; pro- and mesonotum in profile convex and rounded above, the latter without a torus; epinotal base longer than the declivity; spines small, slender, erect and rather blunt at their tips. Petiole nearly three times as long as broad, with concave sides, its node narrow, with blunt, entire upper margin. Postpetiole less than twice as broad as the petiole, nearly as long as broad, convex above, with feebly angular sides. Gaster somewhat smaller than the head.

Mandibles, head, thorax and pedicel subopaque; gaster shining; mandibles striatopunctate; clypeus and head longitudinally rugulose, the latter with finely punctate interrugal spaces; thorax and pedicel finely and densely punctate; pronotum above vermiculately or reticulately rugulose-punctate.

Hairs whitish, sparse and erect on the body, much shorter and more appressed on the appendages.

Brown, with slightly paler appendages; gaster black, with brown posterior margins to the segments.

Described from six soldiers and six workers, taken in the valley of the Santa Cruz River, near Tucson, Arizona, in the same place as the preceding species. The colonies were small and contained very few soldiers. Like the preceding this species is probably carnivorous. The nests were perfect craters, 3–5 inches in diameter, with a large central opening half an inch in diameter.

Pheidole virago is related to *Ph. guilelmi-muelleri* Mayr and *androsana* Whlr., but the sculpturing of the head of the soldier is more extensive and of a different character in both of these species, and the antennal scape in *guilelmi-muelleri* is dilated and flattened, while *androsana* has a smooth, differentiated, scrobe-like area for the antennal scape and the frontal carinæ are prolonged backwards.

19. **Pheidole fimbriata** *Roger.*

Some years ago I described a large deälated female *Pheidole* taken by Oslar at Nogales, Southern Arizona, as *Ph. rhea.* More recently I received from Dr. A. G. Ruthven several winged specimens of this same ant from Cuatololapan, Vera Cruz, Mexico, accompanied by the soldiers and workers. The latter prove on examination to be specimens of *Ph. fimbriata* Roger, a species widely distributed through tropical America, so that the name *rhea* must be relegated to the synonymy. The wings of the female are nearly 16 mm. long, heavily infuscated, with dark brown veins and stigma.

20. **Pheidole tepicana cavigenis** subsp. nov.

Soldier. Differing from the typical *tepicana* Pergande in the shape and sculpture of the head, the shape of the pedicel and in color. The head is proportionately shorter and the sides are straight and subparallel (in *tepicana* feebly convex) but distinctly concave at and in front of the eyes, with the anterior angles prominent and everted. The eyes are distinctly larger and more convex, the rugæ on the front and sides of the head are more distinct, but the transverse rugæ on the occiput are feebler and more reticulate. The petiolar node is perceptibly emarginate (entire in *tepicana*), and the postpetiole is decidedly broader. The thorax and petiole are concolorous with the head, the mesonotum infuscated and the vertex with a black spot.

Described from three specimens (one immature) taken from a single small colony in Miller Cañon, Huachuca Mts., Arizona (5600 ft.). These have been compared with Mexican specimens of a form which agrees very closely with Pergande's *tepicana*, except in color.

21. **Pheidole kingi torpescens** subsp. nov.

Soldier. Differing from that of *kingi* and its subspecies *instabilis* Emery in the shape of the head, which is distinctly shorter in proportion to its width and decidedly broader behind than in front (if anything broader in front than behind in *kingi* and *instabilis*), with the occipital excision deeper and the occipital groove broader. The intermediates also have the same type of head, whereas in the forms previously mentioned it is distinctly broader in front than behind. In *instabilis* the head is darker in color, while in *torpescens* it is uniformly ferruginous red as in the soldier.

Worker. Colored like the worker of the true *kingi* and therefore paler than in *instabilis*, with the antennal scapes extending well beyond the posterior corners of the head as in that form (in *kingi* reaching only a little beyond the posterior corners). The epinotum bears minute spines or teeth as in *kingi*. These are reduced to mere angles in *instabilis*.

Described from single soldier and worker specimens and two intermediates taken from a small nest under a stone near the Carnegie Desert Laboratory at Tucson, Arizona.

22. **Pheidole xerophila pacifica** subsp. nov.

Soldier. Differing from the typical *xerophila* Wheeler in the following particulars: the head is slightly broader behind, much less punctate on its posterior $\frac{3}{5}$ and therefore as in the subsp. *tucsonica* Wheeler and of a deeper red color, with a black spot on the vertex. The sculpture of the thorax is much as in the typical *xerophila*, with the pronotum shining, but the petiolar node is excised as in *tucsonica*. The epinotal spines are more slender and somewhat longer than in either of the previously described forms. The thorax, pedicel and gaster are dark chestnut brown or blackish, the legs and posterior edges of the gastric segments yellowish brown.

Worker. Differing from the workers of *xerophila* and the subsp. *tucsonica* especially in the sculpture of the head and in the paler color. The head is subopaque or shining only on the vertex, not glabrous behind the cheeks but with the whole upper surface delicately longitudinally rugulose and reticulate-punctate. Specimens vary from light to dark castaneous brown, the head and thorax being sometimes nearly black, the mandibles, clypeus, antennæ and legs light yellowish brown.

Female. Length: 5.5–6 mm.

Head subrectangular, broader than long, broader behind than in front with straight sides and posterior border. Antennal scapes reaching halfway between the eyes and the posterior corners of the head. Thorax as broad as the head, flattened above, base of epinotum half as long as the declivity; spines stout, as long as broad at their bases. Petiole similar to that of the soldier, postpetiole about twice as broad as the petiole, and nearly twice as broad as long, its sides produced in the middle as two rather blunt points. Gaster suboblong, more than twice as long as broad, flattened dorsoventrally. Wings long (nearly 7 mm.).

Mandibles shining, coarsely and sparsely punctate. Head opaque, longitudinally rugose, with punctate or reticulate interrugal spaces. Thorax and gaster shining; pronotum transversely rugose, mesonotum, scutellum and mesopleuræ coarsely and sparsely punctate, mesonotum also with a patch of longitudinal rugæ near its posterior margin. Epinotum, petiole and postpetiole opaque, densely punctate. Gaster with fine piligerous punctures.

Hairs more abundant than in the soldier, but more appressed, short and inconspicuous on the appendages.

Head ferruginous red, borders of mandibles and an ocellar spot black. Remainder of body deep castaneous brown, pleuræ and posterior borders of gastric segments paler; antennæ and legs brownish testaceous. Wings grayish hyaline, with pale brown veins and dark brown stigma.

Male. The head is opaque and densely longitudinally rugulose and punctate (shining in the male *xerophila*), the veins of the wings are somewhat darker and the petiolar node is higher and somewhat more acute in profile than in the type of the species.

Described from numerous specimens of all four phases taken at Pasadena and Lakeside, Southern California, during late November, 1910. The colonies were found on the dry open hills in small crater nests, the periphery of which was often covered with discarded chaff and seeds, proving that the species is a harvester. Only a few soldiers were found in each nest. The presence of males and winged females in late November shows that these phases are probably retained in the nests throughout the winter as in *Prenolepis imparis, Camponotus americanus* etc., and that the nuptial flight as in these ants probably occurs in the very early spring.

23. **Pheidole vinelandica longula** *Emery* var. **castanea** var. nov.

Differing from the typical *longula* in its much darker coloration, the body of the soldier being rich chestnut brown, the anterior border of the gaster, the posterior border of the head, the cheeks, disks of mandibles, clypeus, legs, antennæ, pleuræ and epinotum somewhat paler and more reddish. The coloration of the worker is similar, except that the posterior portion of the head and the anterior portion of the gaster are dark like the remainder of these regions.

Described from six soldiers and thirteen workers taken in Miller Cañon, Huachuca Mts., Arizona, at an altitude of 6000 ft.

24. **Pheidole vinelandica cerebrosior** subsp. nov.

Soldier. Like the typical *vinelandica* in color, sculpture and pilosity, but the head decidedly larger though not proportionally longer, and with the postpetiole twice as broad as the petiolar node and produced on the sides as pointed conules.

Worker. Differing from the worker of the typical *vinelandica* only in having the fine punctuation of the thorax and pedicel stronger and these parts therefore more opaque and the erect hairs somewhat less abundant and more obtuse at their tips.

Described from thirteen soldiers and ten workers taken in the dry desert near Tucson, Arizona.

25. **Pheidole californica** *Mayr.*

Considerable series of this ant collected in various localities in California enable me to state that Emery's account of its characters and of those of his *oregonica* needs revision. He states that the transverse rugæ on the back of the head of the soldier of *californica* pass over on the sides into the longitudinal rugæ (of the cheeks), but this is not implied in Mayr's description, it is not the case in a typical specimen of *californica* which Emery kindly sent me many years ago nor is this condition apparent in any of the numerous specimens I have since seen.

The *soldier* of the species measures 2.3–2.5 mm. and may be readily recognized by the following characters: The head is decidedly longer than broad, a little broader behind than in front, with feebly convex sides, flattened above and below, with its greatest dorsoventral diameter through the eyes, the posterior orbits of which are at the anterior third of the head. The transverse occipital rugæ are coarse and reticulate as Mayr states, and terminate on the posterior corners. The anterior third of the head is strongly, longitudinally rugose and between this sculptured region and the posterior rugæ the surface is very shining and sparsely and coarsely punctate. The thorax is densely punctate and shagreened and subopaque, with the exception of the pro-mesonotal convexity, which is smooth and shining. The postpetiole is, as stated by Emery, trapezoidal, broadest through its anterior corners, which are rounded. Specimens of the typical coloration are rufo-testaceous, with the legs yellow and the gaster somewhat infuscated. The hairs are yellowish, rather long and abundant, of uneven length on the body, suberect on the body and scapes, short and subappressed on the legs.

The *worker* measures 1.6–2 mm., has the head very smooth and shining, the thorax sculptured as in the soldier, the postpetiole small and subglobular, the epinotal spines small, as long as broad at the base. Pilosity similar to that of the soldier but sparser. Coloration rufotestaceous, upper surface of head and gaster dark brown; legs, clypeus, mandibles and antennæ yellow.

The *female* (deälated) measures nearly 4 mm.

Head about as broad as long, subrectangular with straight sides and broadly excised posterior border, rather convex above. Antennal scapes reaching to half the distance between the eyes and the posterior corners. Thorax as broad as the head, oval, narrowed behind, the mesonotum and scutellum very flat. Epinotal spines short, triangular, acute. Petiolar node in profile acute, its border seen from behind straight, transverse and entire. Postpetiole less than twice as broad as the petiole, broader than long, with blunt lateral conules. Gaster elongate elliptical.

Head longitudinally and coarsely rugose, except the occiput, which is transversely rugose and very coarsely punctate. Thorax opaque and densely punctate, except the mesonotum and scutellum, which are smooth and shining, with a few sparse punctures. Petiole and postpetiole opaque and densely punctate, except the node of the latter, which is smooth and shining. Gaster shining, with fine, sparse, piligerous punctures.

Pilosity similar to that of the soldier but shorter and more uniform; hairs on the legs and antennal scapes more appressed.

Rufotestaceous; legs somewhat paler; mandibles, gaster and anterior portion of head darker and brownish, posterior margins of gastric segments yellowish.

Described from numerous soldiers and workers and one female from the following localities in California: Palo Alto (H. Heath and W. M. Mann and Wheeler); Brookdale and Santa Cruz Island (R. V. Chamberlin). The type locality is San Francisco (Schaufuss).

26. **Pheidole californica** *Mayr* var. **incenata** var. nov.

Slightly smaller than the typical form and differing in color, the whole body being yellow in the soldier and worker, except the mandibles and sides of the clypeus in the former, which are red, and the top of the head of the latter, which is somewhat infuscated.

Nine soldiers and as many workers taken by Prof. H. Heath at Palo Alto, California.

27. **Pheidole californica** *Mayr* var. **satura** var. nov.

Fully as large as the type but differing from it and the var. *incenata* in color. The soldier has the mandibles, head, thorax, and pedicel deep chestnut brown, the borders of the mandibles and the gaster black, the legs brownish yellow with the middle portions of the femora infuscated. The worker has the head, gaster and pronotum deep castaneous, the remainder of the thorax, mandibles, the pedicel clypeus, antennæ and legs brownish yellow, the femora darker, except at their bases and tips.

Described from numerous soldiers and workers taken on Santa Cruz Island, California, by Dr. Ralph V. Chamberlin and at Palo Alto, Cala., by Prof. H. Heath.

28. **Pheidole californica oregonica** *Emery.*

Emery described this ant as a species, but I believe that it is no more than a subspecies bearing the same relation to the typical *californica* that the typical *Ph. vinelandica* Forel bears to its subspecies *longula* Emery. The head of the *oregonica* soldier is distinctly shorter in proportion to its width than that of *californica*, and the frontal and occipital rugæ are sharper and finer; the latter are not reticulate, and the punctures on the smooth portions of the head are much finer and less conspicuous. The postpetiole has more acute anterior angles. There is some variation in color, but none of my specimens is as dark as those described by Emery. I am unable to distinguish the workers of this form from those of *californica* by any reliable characters. Three females (deälated) measure 3.5 mm. and differ from the same sex of *californica* in having the head less coarsely sculptured and the post-petiole with more acute and longer lateral conules. The body is reddish testaceous, with a large spot on the ocellar region, three longitudinal bands on the mesonotum and the gaster behind the first segment, dark brown; legs yellowish.

Numerous specimens from the following localities; Marion County, Oregon (P. J. Schmitt), Almota, Washington (A. L. Melander); Wawawai and Pullman, Washington (W. M. Mann); and Julietta, Idaho (J. M. Aldrich).

29. **Pheidole californica nevadensis** subsp. nov.

Soldier. Resembling the typical *californica* in coloration and the shape of the head, but its sculpture is more like that of *oregonica*, with sharp, more reticulate and slightly more delicate occipital rugæ and feebler punctures on the smooth area. The thorax, however, is smooth and shining throughout, even the epinotum and the anterior corners of the postpetiole being rather sharp as in *oregonica*. In the worker the antennal scapes do not reach beyond the corners of the head and are therefore decidedly shorter than in either *californica* or *oregonica*. The thorax is smooth and shining even in the epinotal region as in the soldier. A single deälated female measures only 3.5 mm. The head is more shining and less heavily sculptured than in *californica* and the cones of the postpetiole are less produced than in *oregonica*. The body is rufo-testaceous, with a spot on the ocellar region, the mesonotum, scutellum, pedicel, and gaster castaneous. Antennæ and legs yellow, the middle portions of the femora brown.

Described from a female, four soldiers and five workers taken by Mr. W. M. Mann at Pyramid Lake, Nevada.

30. **Pheidole californica micula** subsp. nov.

Soldier. Length: 2.4–2.6 mm.

Head narrower and smaller than in the typical *californica*, with shallower occipital excision and more rounded occipital lobes, the rugæ and punctures on the head very fine and indistinct so that its whole surface is more shining; the occipital rugæ, however, very sharp and regular, not reticulate. Thorax and pedicel subopaque, very finely and densely punctate, humeri with a few rugules, pro- and mesonotum above rather smooth and shining. Gaster glabrous and shining. Epinotal spines and anterior angles of postpetiole very blunt. Color yellow; gaster, legs and antennæ paler, mandibles often reddish, their borders and the anterior edge of the clypeus black.

Worker. Length: 1–1.3 mm.

Head more rectangular, with less convex sides than in the preceding forms; antennal scapes not extending beyond the posterior corners of the head. Sculpture of thorax and petiole as in the soldier; head very smooth and shining. Color yellow, mandibles, clypeus, antennæ and legs somewhat paler, dorsal surface of head slightly brownish.

Six soldiers and six workers taken from a single colony in Miller Cañon, Huachuca Mts., Arizona (5300 ft.). This may be a distinct species, but for the present I prefer to regard it as a very pronounced subspecies of *californica.*

31. **Pheidole hyatti solitanea** subsp. nov.

Soldier. Length 3–3.3 mm.

Even darker in color than the var. *ecitonodora* Wheeler; legs brown; decidedly smaller than this variety and the type of the species, and with the antennal scapes considerably longer, so that they reach nearly to the posterior corners of the head, epinotal spines a little more slender.

Worker. Length 2 mm.

Smaller than the worker of *hyatti* and the var. *ecitonodora,* with the posterior portion of the head and upper portion of the pronotum more glabrous and shining, and without rugules and punctures.

Female. Length: 4.5–5 mm., wings 6 mm.

Very small compared with the female of other forms of the species. Red; gaster dark brown, reddish at the base of the first segment; posterior borders of segments yellowish; antennal scapes reaching a little beyond the posterior corners of the head, somewhat less dilated at the base than in other forms of the species.

Described from seven soldiers and seven workers taken by myself on Point Loma, near San Diego, California, and a single soldier and three females taken by Mr. Percy Leonard in the same locality.

32. **Pheidole crassicornis vallicola** subsp. nov.

Soldier. Length: 3.5–4 mm.

Differing from the typical *crassicornis*, its var. *diversopilosa* Whlr. and its subsp. *porcula* Whlr. with the var. *tetra* Whlr. in sculpture, pilosity and coloration. The mandibles are coarsely striatopunctate over their whole upper surface, the clypeus is subopaque and rugulose in the middle, and the reticulate rugæ on the anterior portion of the head are coarser. The pronotum above is shagreened and rugulose and only slightly shining, the postpetiole densely punctate and subopaque like the petiole.

The pubescence on the head, gaster, and appendages though sparse, is long and conspicuous; the erect hairs are long, pointed and very sparse, but conspicuous on the occiput, thorax, pedicel and gaster. Both hairs and pubescence are pale yellow. The body is dark chestnut brown, the mandibles, except their borders, the middle of the clypeus and the cheeks and front are deep red. Antennæ dark brown, legs paler brown.

Worker. Length: 2.3–2.5 mm.

Deep castaneous, head and gaster darker, mandibles, clypeus and legs reddish brown; punctuation of the head, thorax and pedicel coarser and deeper than in the typical *crassicornis*, only a median streak on the head and a small median spot on the thorax shining. Erect hairs more abundant than in the soldier, of uneven length and pointed; scapes with a few suberect hairs, legs with numerous more oblique hairs.

Described from seven soldiers and eleven workers taken in Miller Cañon, Huachuca Mts., Arizona (alt. 5000 ft.).

33. **Stenamma brevicorne heathi** subsp. nov.

Worker. Differing from all the known North American forms of *brevicorne* in sculpture and in its much paler color. The insect is light ferruginous red throughout, the legs and gaster very slightly paler than the head and thorax. Some specimens have a vague brownish spot on the vertex. The occiput and upper surface of the thorax are slightly shining. The rugæ of the pro- and mesonotum are coarse and reticulate and without longitudinal trend as in the other forms. Rugæ of the postpetiole similarly coarse and reticulate. Spines of the epinotum very acute, fully as long as broad at their bases. Peduncle of petiole with a small tooth anteriorly on the ventral side. Eyes small, with not more than four ommatidia in their greatest diameter. Antennal scapes a little longer than in *brevicorne* and its varieties and reaching very nearly to the posterior corners of the head.

Described from 25 workers taken from a single colony in King's River Cañon, California, by Prof. Harold Heath. This form may deserve to rank as a distinct species when the winged phases are discovered.

34. **Messor chamberlini** sp. nov.

Worker. Length: 4–4.3 mm.

Closely related to *M. andrei* Mayr, but much smaller, of a different color and with different petiole and epinotal spines. The pro- and mesonotum together are more convex and rounded above; the epinotal spines are not longer than the epinotal declivity, slightly curved, more rapidly tapering and more slender at their tips and directed somewhat more upward and less backward than in *andrei*. In profile the petiole has a lower and more rounded node and its ventral surface is straight or slightly concave in outline (in *andrei* with a distinct median protuberance). The sculpture is like that of *andrei*, but not so coarse and the general surface is a little more shining. The hairs on the body are less abundant, those on the gula longer and forming a more distinct psammophore. The whole body is ferruginous red, except the middle portions of the femora and tibiæ and the gaster posterior to the middle of the first segment. These regions are dark brown or blackish. Mandibular and clypeal borders black.

Described from 18 workers taken by Dr. R. V. Chamberlin on Santa Cruz Island, off the coast of Southern California.

35. **Aphænogaster subterranea valida** subsp. nov.

Worker. Length: 4–5.5 mm.

Differing from the subsp. *occidentalis* Emery in the more robust build of the large workers, the broader head, slightly shorter antennal scapes, heavier sculpture and much darker color. The rugosity and punctuation of the head, pleuræ and epinotum are much coarser, so that these parts and especially the epinotum are subopaque. The occiput and dorsum of the pro- and mesonotum are shining, but the mesonotum is distinctly shagreened (smooth in *occidentalis*). The epinotal spines are somewhat longer and stouter than in this subspecies. The head, thorax, petiole and gaster are deep chestnut brown, the legs and articulations of the tarsi, the neck, clypeus, frontal carinæ, antennæ, mandibles and sutures of the thorax deep red; middle portions of the femora and tibiæ somewhat darker.

Female. Length: 6–6.5 mm.

Differing from the female of *occidentalis* only in the somewhat broader and more rectangular head, slightly shorter antennal scapes and darker color. In both subspecies the mesonotum and scutellum are very smooth and shining, and the wings are long and hyaline, with pale yellow veins and brown stigma.

Male. Length: 4–5 mm.

Indistinguishable from the male of *occidentalis* except in the slightly darker and more blackish color of the body and the more distinctly shagreened though scarcely less shining mesonotum. Wings colored as in the female.

Described from seven females, five males and numerous workers taken from two colonies in Cheyenne Cañon, near Colorado Springs, Colo. These colonies were very populous and were nesting under huge stones, and one of them was beginning its nuptial flight when I came upon it. There is a distinct tendency to polymorphism in the worker caste, the smaller individuals closely resembling the only worker phase of the subsp. *occidentalis.* The colonies of the latter are very small compared with those of *valida.* I have compared this form with topotypes of *occidentalis* taken by Mr. W. M. Mann at Pullman, Washington and with long series of specimens from other localities in that state, Oregon, California, Utah, Colorado, Idaho and Montana.

36. **Aphænogaster subterranea borealis** subsp. nov.

Worker. Length: 4.5–5.5 mm.

Differing from *valida, occidentalis* and the typical *subterranea* in sculpture and coloration. The whole head is rugulose-punctate so that the occipital region is not or only very slightly shining. The pro- and mesonotum, too, are subopaque and densely punctate. The antennal scapes are of the same length as in the other subspecies, except *valida*. The gaster and nodes of the petiole and postpetiole are deep chestnut brown, the remainder of the body light brown, the head, especially behind, somewhat darker, the legs a little paler.

Described from 13 workers taken by Prof. J. Chester Bradley at Lardo, Kootenay Lake, British Columbia.

37. **Aphænogaster mutica** *Pergande.*

This species was originally described by Pergande from San Jose del Cabo at the tip of Lower California. Dec. 16, 1901, I took a single worker specimen at Terlingua, Brewster Co., Texas, in the Great Bend of the Rio Grande. I have also received two workers from Dr. C. H. Tyler Townsend who took them at Cerro Chilicote in Chihuahua, Mexico. All of these specimens agree perfectly with Pergande's description.

38. **Aphænogaster texana** *Emery.*

Emery described this ant from two workers as a variety of *A. fulva* Roger, but study of a large series of specimens of all three phases convinces me that it should rank as a distinct species, which is, however, almost halfway between *A. fulva* and *A. mutica* Pergande. The head of the worker *texana* is more slender than that of *fulva*, including the mandibles twice as long as broad, and narrowed behind the eyes, so that the occipital region is not nearly as broad as in *fulva* and without posterior corners. The eyes are distinctly larger, the antennæ decidedly longer, the scapes extending fully $\frac{1}{3}$ of their length beyond the posterior border of the head, the individual joints of the funiculi longer and more slender. The basal teeth of the mandibles are larger and more nearly of the same size as the apical teeth. The epinotum is longer, its spines are short, acute, directed upward and very slightly backward. The postpetiole is more voluminous, compared with the petiole, and its node is more rounded. The head and thorax are opaque and very densely punctate, the clypeus much smoother and more shining than in *fulva*, the thorax, petiole and postpetiole uniformly and densely punctate and opaque, except the epinotum, which is somewhat rugulose on the sides. The color is uniformly light ferruginous red, with slightly more yellowish gaster and legs. In some specimens the gaster is indistinctly infuscated posteriorly.

The female measures 11–11.5 mm. and is colored like the worker, the wings are yellowish hyaline, with pale yellow veins and brown stigma. They are longer than in *fulva*. The female *texana* differs from the female *fulva* also in the shape of the head, which is narrower behind and therefore more elliptical, the eyes are more convex and the antennæ distinctly longer, though their scapes do not reach so far beyond the posterior borders of the head as in the worker. The clypeus is finely rugulose-punctate and opaque as in *fulva*. The difference in the size of the postpetiole is even greater in the females of the two species.

The male *texana* measures 4–5 mm. and is much paler than the male *fulva*, being reddish brown, with the head dark brown, the mandibles, antennæ and legs light yellow, but the main difference is in the shape of the epinotum. The two protuberances of this region, representing the spines of the worker, are much inflated and bluntly rectangular in profile in *fulva*, whereas in *texana* they are much less swollen and acutely pointed.

I have frequently taken this ant nesting in rather small colonies under stones in shady woods and ravines about Austin and New Braunfels, Texas. A very similar form, but slightly darker in the worker phase and tending towards the variety described below, was collected in the Indian Garden on the Bright Angel Trail in the Grand Cañon, Arizona. Four workers received from Miss Anna Klaumann and taken at Douglas, Kansas (alt. 900 ft.) are indistinguishable from Texan specimens.

39. **Aphænogaster texana** *Emery* var. **furvescens** var. nov.

Worker. Differing from the typical form only in color, which is reddish brown, with the gaster dark brown, except at the extreme base. In some specimens the head and nodes of the petiole and postpetiole are also distinctly infuscated.

Female (deälated). Length: 7.5 mm.

Like the worker, differing from the female *texana* in color, the body being rich brownish red, the basal half of the gaster, wing-insertions and a broad V-shaped blotch on the head, with its apex on the vertex and its two limbs running forward between the eyes and frontal carinæ, blackish.

Several workers and a single female from two localities in the Huachuca Mts., Arizona, namely Miller Cañon, 5800 ft. (Wheeler) and Ramsay Cañon, same altitude (W. M. Mann).

40. **Aphænogaster texana** *Emery* var. **carolinensis** var. nov.

Worker. Length: 4–5 mm.

Averaging somewhat smaller than the typical *texana*, with the epinotal spines nearly as long but less erect and directed more backward. The ground color of the body is less red and more brownish, with the dorsal surface of the head, thorax, pedicel and gaster varying from light to dark brown, the base and tip of the gaster paler, antennæ ferruginous, legs yellow; sculpture of the head more pronounced than in *texana.*

Female (deälated). Length: 5.5 mm.

Decidedly smaller than the female *texana*, with narrower clypeal emargination, shorter thorax, and the petiolar node more acute in profile; gaster less voluminous, broadly elliptical. Color much as in the worker.

Described from a single female and numerous workers taken from several small colonies nesting under stones in open woods at Tryon, North Carolina.

41. **Leptothorax eldoradensis** sp. nov.

Worker. Length: 1.8 mm.

Head subrectangular, longer than broad. Mandibles 5-toothed. Clypeus with entire anterior border, which is straight in the middle and not produced, its upper surface impressed in front at the margin. Antennæ 12-jointed; scapes reaching to the posterior corners of the head; funicular joints 2–8 slightly broader than long; two basal joints of club together nearly as long as the terminal joint. Thorax rather short and robust, scarcely longer than the head with the mandibles, decidedly broader in front than behind, with rounded humeri, the sides of the meso- and epinotum subparallel. In profile the dorsal outline is convex in front, straight in the middle and sloping in the epinotal region, both the base and declivity of the latter being subequal and having the same slope; spines reduced to very small, acute teeth, which are shorter than broad at their bases. Petiole from above but little longer than broad, scarcely pedunculate, with straight, subparallel sides; in profile the node is rather high with angular summit, the anterior slope long and distinctly concave, the posterior short and abrupt. Postpetiole small, scarcely half again as broad as the petiole, a little broader in front than behind, convex and subelliptical in outline when seen from above. Gaster elliptical, with straight anterior border. Legs rather slender, the femora and tibiæ feebly clavate.

Head, thorax, pedicel and appendages subopaque, the head slightly shining on the vertex and occiput; gaster smooth and shining. Mandibles rather coarsely striato-punctate; clypeus with three strong median longitudinal carinæ or rugæ and numerous feebler rugæ on the sides. Head, thorax, petiole and postpetiole densely and evenly punctate; head also longitudinally rugulose. Legs and scapes more finely punctate-shagreened.

On the body the hairs are white, erect, obtuse but not clavate, and sparse; on the appendages they are delicate, pointed, appressed and more numerous.

Chestnut brown; gaster paler at the base; mandibles and legs yellowish brown; femora and tibiæ infuscated in the middle.

Described from two workers taken by Dr. J. C. Bradley on the summit of Mt. Wilson, near Pasadena, California. This species may be mistaken for *L. neomexicanus* Wheeler, but it is smaller, the thorax is stouter and of a different shape, the epinotal spines are much shorter, the petiolar node more acute in profile and the postpetiole decidedly smaller.

42. **Leptothorax (Mychothorax) hirticornis formidolosus** subsp. nov.

Worker. Length: 2.5–2.75 mm.

Agreeing with Emery's description of the typical *hirticornis*, except in the following particulars: The spines of the epinotum are not compressed, the petiolar node is scarcely angular but rounded in profile, the color in mature specimens is darker, the body being brownish ferruginous, the upper surface of the head and the gaster, except the extreme base and tip of the latter, dark brown. The legs and antennal scapes are opaque and densely punctate like the thorax. The tips of the mandibles, the clypeus along the middle line and posteriorly and a short median line on the front are shining. The postpetiole is distinctly broader than long, trapezoidal, with its anterior broader than its posterior border and its sides straight. The gaster is regularly elongate elliptical, narrowed in front to its insertion on the postpetiole. Body, including the antennal scapes and legs covered with short clavate hairs as in the typical *hirticornis*.

Female (ergatoid). Length: 2.8 mm.

Closely resembling the worker, except in the structure of the thorax, which has the female arrangement of the sclerites, but is narrow and shows no traces of having borne wings.

Described from five workers and a single ergatoid female taken by Prof. T. D. A. Cockerell on Flagstaff Mt., near Boulder, Colorado. These are evidently distinct from the typical *hirticornis*, but as I have seen no specimens of this form, I am unable to estimate the precise extent of the differences.

43. **Xiphomyrmex spinosus hispidus** subsp. nov.

Worker. Length: 3.5–3.8 mm.

Differing from the worker of *spinosus* Pergande from the cape region of Lower California, in having the erect hairs on the head and thorax short, stiff and blunt, not longer than those on the gaster, and in the shape of the metasternal angle which is large, flat and rectangular in profile and not in the form of a pointed tooth. The hairs on the legs are coarse and suberect. The epinotal spines are distinctly shorter than their distance apart at the base. The posterior border of the head is distinctly excised and there is a faint transverse dorsal impression between the meso- and epinotum. The postpetiole is less than twice as broad as long and about half again as broad as the petiole, its upper surface is rather finely and vermiculately rugose. Only the anterior half of the first gastric segment is subopaque and finely striolate-shagreened. The antennal funiculi are not infuscated at their tips.

Described from a long series of workers which I found nesting in small craters 3–4 inches in diameter in the deserts around Tucson, Arizona (type locality) and five workers from Phœnix in the same state.

44. **Xiphomyrmex spinosus wheeleri** *Forel.*

Forel described this ant as a distinct species from specimens which I took many years ago in the dry desert at Pacheco, in Zacatecas, Mexico, but a study of three cotypes in my collection shows that it can hardly be more than a subspecies of *spinosus*. As stated by Forel, it differs from *spinosus* in having a distinct mesoëpinotal constriction, in the shape of the metasternal angles which are small and blunt, in the stouter epinotal spines and in having the first gastric segment, except for the scattered piligerous punctures, smooth and shining. The hairs on the legs are oblique, those on the body are pointed, of unequal length, but on the whole decidedly longer than in the preceding subspecies. The clubs of the antennal scapes are infuscated. The head is not more deeply excavated behind than in *hirsutus*, but the upper surface of the petiole is coarsely longitudinally rugose.

I refer two workers which I took in Miller Cañon, Huachuca Mts., Arizona, to this subspecies though their epinotal spines are distinctly smaller and the rugosity of the postpetiole is more irregular than in the Mexican cotypes. The antennal clubs are not infuscated. The Arizona specimens may represent a distinct variety but the material is hardly sufficient to justify the introduction of a new name.

45. **Xiphomyrmex spinosus insons** subsp. nov.

Worker. Length: 3.5–4 mm.

Very similar to the subspecies *wheeleri*, with the epinotal spines long and slightly curved at their tips, the metasternal angles produced into sharp, compressed spines nearly half as long as the epinotal spines, with acute, upturned tips. The postpetiole is twice as broad as long and about $\frac{1}{3}$ as broad again as the petiole, its upper surface coarsely and regularly longitudinally rugose, the gaster smooth and shining, with small, scattered, piligerous punctures. Head very distinctly excised behind; thorax without mesoëpinotal constriction or impression. Erect hairs on the body long and abundant, of unequal length and pointed as in *wheeleri*, those on the legs reclinate. Some specimens show a slight infuscation of the antennal clubs.

Female. Length: 4–4.5 mm.

Closely resembling the worker; pronotum and epinotal declivity transversely, mesonotum, scutellum and pleuræ coarsely, longitudinally rugose. Wings yellowish hyaline, with pale brown veins and darker brown stigma.

Male. Length: 3.5–4 mm.

Head, excluding the mandibles, about as long as broad, with very short cheeks, rounded sides behind the eyes and distinctly excavated posterior border. Mandibles well-developed, with dentate borders. Clypeus convex, with three longitudinal ridges, its anterior border entire. Antennæ 10-jointed; scape as long as the second funicular joint, which is four times as long as the first and longer than joints 3–5 taken together. Thorax rather large, elliptical, broader than the head; mesonotum with distinct Mayrian furrows; epinotum unarmed, feebly convex and steep, without distinct base and declivity. Petiole with a peduncle nearly as long as the rounded node. Postpetiole transverse, about $1\frac{1}{2}$ times as broad as long, rounded above and on the sides. Gaster narrow; legs slender.

Shining; mandibles smooth; head rugose-punctate; thorax and petiole longitudinally rugose, pleuræ and epinotum more opaque, gaster and dorsal surface of petiole smooth and shining.

Hairs yellowish, long and erect, much as in the worker but proportionally longer on the legs.

Black; mandibles and tip of gaster sordid yellow; clypeus, antennæ and legs piceous; tarsi and articulations of legs yellowish. Wings brownish hyaline, with brown veins and stigma.

Described from numerous specimens taken by myself in the following localities:

Texas: Austin (type locality); New Braunfels, Alamito in Brewster County, Alice, San Angelo, Fort Davis, Kenedy, Langtry, Barkdale and Del Rio.

Arizona: Miller Cañon, Huachuca Mts.

This ant nests in small craters in dry, grassy places. There are scarcely more than 70 individuals in a colony. The workers are very timid and forage singly; the winged phases appear during the first week in June.

Subfamily Dolichoderinæ.

46. **Dolichoderus (Hypoclinea) taschenbergi** *Mayr* var. **aterrimus** nom. nov.

This name is suggested for the var. *gagates* Wheeler as Emery had previously described a *Dolichoderus* (*Monacis*) *gagates* from Parà, Brazil.

47. **Bothriomyrmex dimmocki** sp. nov.

Worker. Length: 1.6–1.8 mm.

Closely resembling the Mediterranean *B. meridionalis* but with eyes nearly twice as large and the distance between the eyes and the anterior borders of the head nearly equal to the length of the eyes. The clypeus is proportionally longer and more convex and slightly sinuate in the middle of its anterior border. Maxillary palpi rather long, 4-jointed as in the European form, but all the funicular joints of the antennæ are distinctly longer than broad. Sculpture of body and pubescence as in *meridionalis* but the color of the head, thorax, coxæ and petiole rather rich brownish red, the gaster dark brown, the mandibles, antennæ and legs dull yellow.

Female. Length: 1.8 mm.

Resembling the worker, except in the structure of the thorax. Eyes scarcely larger than in the worker; ocelli minute. Corners of clypeus distinctly inflated. Mesonotum impressed in the middle behind. Wings hyaline, with pale veins and stigma. The fore wing differs from that of *meridionalis* in lacking the closed discal cell. The color, sculpture and pubescence of the body as in the worker.

Described from two workers, one winged and four deälated females taken by Dr. George Dimmock August 27, 1897, from a single colony on Mt. Tom, near Springfield, Mass.

This insect presents an interesting problem. The seven species of *Bothriomyrmex* hitherto described are all from the Old World, three from the European and African littoral of the Mediterranean, and four from Southern Asia, Java and Australia. The Mediterranean species, as Emery has shown, have 4-jointed, those of Asia and Australia 2-jointed maxillary palpi. The species discovered by Dr. Dimmock agrees with the Mediterranean form in this character but the wings seem to be very different. As nearly as I can make out from the single rather immature specimen of *dimmocki* possessing these organs, the venation is aberrant in lacking the discal cell. This I find to be the case also in a number of male specimens of the Australian *pusillus* Mayr. On receiving the specimens from Dr. Dimmock I doubted the occurrence of a *Bothriomyrmex* in Massachusetts and surmised that there must be some mistake in the label, but he informs me that he certainly took the specimens on Mt. Tom. Then it occurred to me that the form might have been accidentally introduced from abroad, but the species is certainly not one of the seven described forms, six of which I have seen, and the description of *B. walshi* Forel of Bengal, the only one lacking in my collection, does not apply to the Massachusetts specimens. It seems probable therefore that *Bothriomyrmex* is really an indigenous North American genus, but one which is here very rare and on the road to extinction. This conclusion is the more likely since Santschi has shown that the Mediterranean species, at least, are temporary social parasites on *Tapinoma erraticum* after the manner of the species of *Formica* belonging to the *rufa* and *microgyna* groups. The fecundated diminutive queen of *B. meridionalis* and *decapitans* enters the *Tapinoma* nest, and after decapitating the queen of the colony, is adopted by the workers and becomes the mother of the future *Bothriomyrmex* community. We are therefore justified in supposing that *B. dimmocki* behaves in a similar manner towards our common *Tapinoma sessile,* and if we assume that this ant has almost completely outgrown the toleration of its parasite, we can understand why the latter is so very rare and local that it has never been taken except by Dr. Dimmock.

Subfamily CAMPONOTINÆ.

48. **Polyergus lucidus montivagus** subsp. nov.

Worker. Differing from the typical *lucidus* of the Eastern States in the distinctly paler and more yellowish red color of the body, in not having the gaster infuscated at the tip, in the complete or nearly complete absence of erect hairs on the posterior corners of the head, the smaller number of hairs on the gula and the distinctly less shining surface of the head and thorax.

Female. Colored like the worker and not like the female of *lucidus*, which has the head, thorax and petiole of a striking, dark fuscous red tint. The wings, too, are paler with paler veins and stigma and the surface of the body, especially of the head and thorax, is distinctly less glabrous and shining. Gaster decidedly larger and longer than in *lucidus.*

Male. Differing from the male *lucidus* in the paler wings, which are whitish hyaline, with colorless veins and pale brown stigma, whereas in *lucidus* the wings are faintly brownish, with brown veins and blackish stigma. The border of the petiole seems to be somewhat more acute in profile and the whole node more compressed anteroposteriorly and even more deeply excised than in *lucidus*. The legs, antennal funiculi and gaster in many specimens are paler and more reddish.

Described from numerous specimens of all three phases taken from several colonies in the cañons about Colorado City and Manitou, Colorado, The winged phases were taken July 11 to 15 and August 11 to 20. The slaves in all the colonies belonged to a form of *Formica schaufussi* Mayr near the variety *incerta* Emery, without erect hairs on the gula and petiolar border, but like the typical form in other respects, though somewhat smaller. The specimens of *montivagus* have been compared with large series of the true *lucidus* from many localities in the Eastern States and leave no doubt that the two forms represent distinct geographical races.

49. **Polyergus rufescens breviceps** *Emery* var. **umbratus** var. nov.

Worker. Length: 6–5.7 mm.

Differing from the typical *breviceps* of Colorado in its somewhat larger size and decidedly darker color, the whole body and appendages being uniformly rich, reddish brown. The head and mandibles are also smoother and more shining than in most specimens of *breviceps.*

Described from numerous individuals taken from a single colony at Brookdale, California, by Prof. Harold Heath. The slave ant accompanying these specimens belongs to a small variety of *Formica fusca* L. near the var. *argentea* Wheeler.

50. **Polyergus rufescens læviceps** subsp. nov.

Worker. Length: 4–5.5 mm.

Decidedly smaller than the subsp. *breviceps* Emery and of the same size as the subsp. *bicolor* Wasmann, but differing from both in the shorter and more sudden enlargement of the tips of the antennal scapes and in the surface of the body which is much smoother and more shining throughout. The head, especially, is conspicuously glabrous and shining. Pubescence on the thorax and gaster as in *breviceps* and the color is the same, except that the apex of the gaster behind and including the posterior margin of the second segment is black. In many specimens the posterior margin of the first segment is also more or less infuscated.

Described from numerous specimens belonging to two companies of workers which I found making slave raids on the slopes of Mt. Tamalpais, near San Francisco, Cala., July 19, 1914. The ants from whose nest they plundered the brood belonged to *Formica subpolita* Mayr.

51. **Camponotus acutirostris** *Wheeler* var. **clarigaster** var. nov.

Worker Major. Length nearly 12 mm.

Differing from the typical *acutirostris* in having the gaster reddish yellow throughout like the thorax; the antennal scapes and first funicular joint, tibiæ and metatarsal joints black; the mandibles nearly black, the clypeus dark red and the tips of the femora infuscated. From the var. *primipilaris* Wheeler it differs in its smaller size and in lacking the infuscation of the gaster and pronotum.

A single specimen taken at an altitude of about 3000 ft. on the Bright Angel Trail in the Grand Cañon, Arizona. The large number of *acutirostris* specimens which I collected in the Huachuca Mts., Arizona, make it seem possible that this form, and its vars. *primipilaris* and *clarigaster* are merely stature and color varieties of *C. ocreatus* Emery, but till I see unmistakable worker specimens of this ant, I hesitate to regard the specific name *acutirostris* as a synonym.

52. **Camponotus yogi** sp. nov.

Worker Major. Length: 8 mm.

Head rectangular, fully $1\frac{1}{4}$ times as long as broad, with straight, parallel sides and broadly excised posterior border; in profile convex above, obliquely truncated anteriorly and flat below. Eyes rather large, elliptical, well behind the middle of the sides of the head. Mandibles small, thick, wedge-shaped in profile, their outer borders convex, their apical borders with five subequal teeth. Clypeus flat, entirely ecarinate, 1½ times as long as broad, as broad behind as in front, slightly broader in the middle. Frontal carinæ strongly diverging in front, approximated and parallel behind. Frontal area indistinct. Antennæ slender; scapes curved and slightly flattened at the base, scarcely enlarged at their tips, which reach to the posterior corners of the head. Thorax short, not longer than the head, broadest through the pronotum which is about ¾ as broad as the head, narrowed and laterally compressed behind, in profile evenly arcuate above, with strong promesonotal and mesoëpinotal sutures; base and declivity of epinotum distinct, the former slightly convex, shorter than the latter, which is abruptly sloping and distinctly concave. Petiole very much compressed anteroposteriorly, with sharp, broadly rounded and entire superior border, the anterior and posterior surfaces very feebly convex. Gaster narrow, nearly as long as the head and thorax together, with parallel sides. Legs moderately long; fore femora somewhat incrassated.

Head behind the eyes, thorax, petiole, gaster and legs shining, smooth, with very fine, sparse and indistinct punctures. Mandibles slightly shining, coarsely and rather densely striatopunctate; clypeus and anterior half of head opaque, densely punctate and covered with coarse, slightly elongate foveolæ. Front with several round foveolæ; vertex punctate. Antennal scapes slightly shining, finely punctate.

Hairs yellowish, slender, sparse, rather short and erect on the body and upper and posterior portion of the head, shorter on the mandibles, very short and obtuse on the clypeus, and sculptured portions of the head where they arise from the elongate foveolæ. Legs with very short appressed hairs except at the knees where they are longer and erect.

Head, petiole, epinotum, mesonotum, gaster and scapes castaneous; pronotum, funiculi and legs paler and more yellowish red or testaceous.

Worker Minor. Length: 4 mm.

Head small, but little longer than broad, rounded behind, a little broader behind than in front, evenly convex above, not truncated anteriorly. Clypeus subcarinate, nearly as broad as long. Mandibles rather narrow. Antennal scapes reaching fully ⅓ their length beyond the posterior border of the head. Thorax and petiole shaped much as in the worker major, but the former proportionally higher through the mesonotum. Gaster less elongate, elliptical.

Mandibles finely striatopunctate, glossy; whole head smooth and shining, like the remainder of the body, not sculptured anteriorly.

Hairs white, delicate, sparse and rather short, not modified on the anterior portion of the head.

Color like that of the worker major, except that the scapes as well as the funiculi of the antennæ are colored like the legs and mandibles and the head is also testaceous in front and castaneous only on the vertex and occiput.

Described from single major and minor workers taken by Mr. Percy Leonard from a hollow twig of manzanita near the Raja Yogi Institute on Point Loma, near San Diego, Cala. This species is unlike any of our other North American *Camponoti*. It clearly approaches the species of *Colobopsis* and should, perhaps, be included in that subgenus, though the peculiar truncated anterior portion of the head is not circular nor distinctly marginate as in such forms as *C. truncatus* Spinola, *impressus* Roger, *abditus* Forel and *pylartes* Wheeler.

59.57,52C(91.4)

Article XIII.— DESCRIPTIONS AND RECORDS OF COCCIDÆ.

By T. D. A. Cockerell and Elizabeth Robinson.

The material for the Philippine Islands, now reported on, taken together with the specimens previously received, permits us to indicate briefly the general character of the Coccid fauna of the islands.

(1.) Cultivated plants, at least in the Island of Luzon, are infested by many species, which are, with few exceptions, those common in tropical countries on the same or similar plants.

(2.) This Coccid fauna of widely distributed species has undoubtedly been introduced by man.

(3.) The truly indigenous Coccid fauna, found principally on native plants, consists mainly, perhaps wholly or almost wholly, of precinctive or endemic species, which are nevertheless allied to those of other tropical Asiatic countries.

(4.) The number of endemic genera appears to be very small, and it may be that when the species of the various Malay islands are well known, it will appear that there are no genera peculiar to the Philippines.

(5.) The above statement must in part be considered provisional, as we know little or nothing of the species occurring in remote, uncultivated parts of the islands.

Diaspinæ.

Schizaspis n. gen. (Diaspinæ.)

Female scale small, circular or almost, flattened, with large exuviæ much like those of *Xanthophthalma*, the first and second skins not separable. Male scale elongate but not parallel sided, white with terminal yellow exuvia, not keeled. Adult female with margins deeply incised, lobed between the incisions; no circumgenital glands; anal orifice large, near hind end; lobes and squames well developed. Immature female oval, not lobed at sides.

Schizaspis lobata new species.

Female scale about .75 mm. diameter, flat, nearly circular, yellowish brown, the surface beaded with little prominences in concentric rows; exuviæ large, sublateral or central, dull golden yellow, broad pyriform.

Adult female yellow when boiled in liquor potassæ, diameter about .5 mm., circular, with seven deep constrictions, the margin between them convex; one constriction or incision is anterior, in the middle line, there is one on each lateral margin at about the level of the mouth, and there are two pairs posteriorly, not far apart, at the sides of the abdominal region. Pygidial region with two pairs of lobes; median stout, trilobed, having two almost equal notches; second lobes prominent rounded projections, slightly shorter than the median lobes, and some distance from them; between the median lobes, which are widely separated, is a pair of fringed plates or squames, much longer than the lobes; a large and long spine and two broad fringed plates laterad of each median lobe; a short fringed plate and a series of spine-

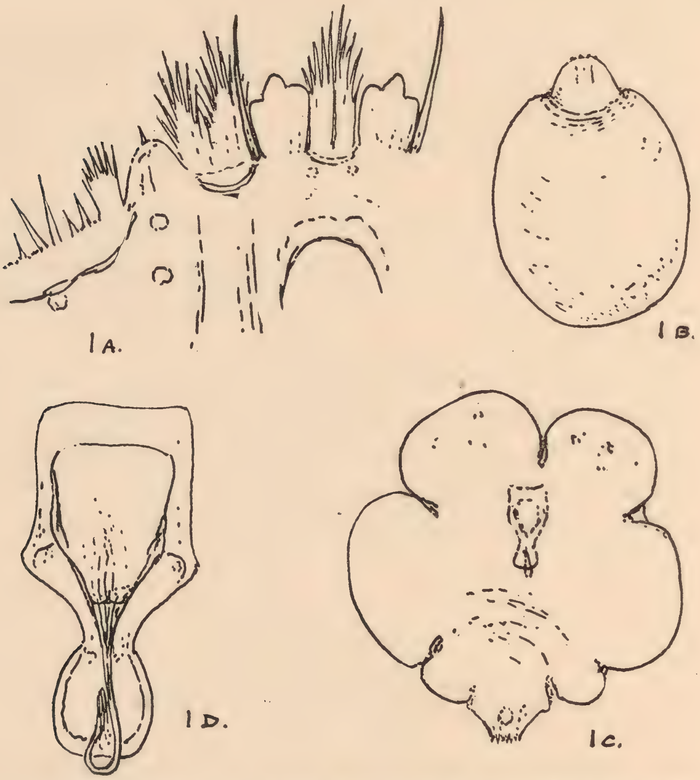

Fig. 1. *Schizaspis lobata.* 1A, caudal structures of adult female full of young; 1B, immature female; 1C, adult female; 1D, mouth parts of adult female.

like structures laterad of the second lobes. Anal orifice large, not far from hind end; genital opening about as far cephalad of anal opening as that is of the bases of median lobes. A few transversely elongated dorsal pores, and near the margin some small circular orifices. Antennæ with a single long bristle.

Male scale nearly 1 mm. long, white, with yellow exuvia; margins convex. Los Baños, Philippine Is., March 20, 1914 (C. F. Baker, 3110). Irregularly scattered in large numbers on under side of leaves of *Ficus nota.*

This could be regarded as an aberrant *Diaspis*, but it is little related to the type of that genus. The lobes, and large anal orifice near the hind end suggest *Hemiberlesia;* the large spine-like structures next to the median lobes, and the character of the dorsal glands of the pygidial area, rather remind one of *Fiorinia.*

Aspidiotus coryphæ n. sp.

Female scale nearly 2 mm. diameter, circular, flat, dull white or pale ochreous; exuviæ sublateral, first skin exposed.

Adult female about a mm. long, pyriform, pale yellow; pygidial area with three pairs of lobes; median lobes large and prominent, almost contiguous, rounded apically, with a single notch on the outer side; cephalad of each median lobe is a

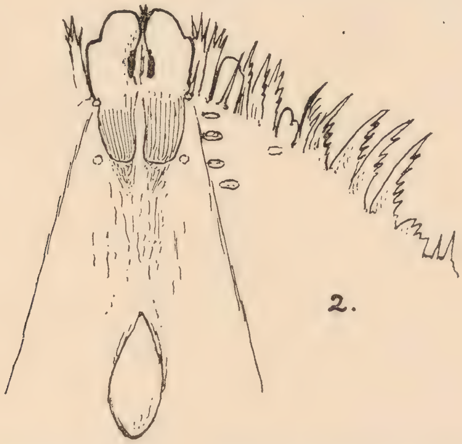

Fig. 2. *Aspidiotus coryphæ.* Caudal structures of adult female.

conspicuous thickening, about the length of the lobe; second and third lobes small and transparent, notched like the median lobes; a small fringed squame between the median lobes; two fringed squames or plates between first and second lobes, three between second and third, and six beyond third, most of the last long and pointed, fringed only on one side; the usual small spines at bases of lobes; anal orifice pyriform, distinctly pointed posteriorly; circumgenital glands in four groups, anterior laterals 7 to 9, posterior laterals 6 to 8.

Los Baños, Philippine Is., Jan. 15, 1915 (Baker, 3291). On leaf-bases of *Corypha elata* Roxb. (*Palmæ*).

Very close to *A. putearius* Green, but easily distinguished by the possession of circumgenital glands and the more closely approximated median lobes. The habitat is also quite different; the insect does not make pits.

Lepidosaphes ixoræ n. sp.

Female scale white, varying to pale purplish brown with the margin white; elongate but rather broad, moderately convex, often somewhat curved, the surface with ridges (as in *Phenacaspis varicosa*) diverging from a centre near the exuviæ; exuviæ orange, about a mm. long. Length of scale about 3.5 mm.

Male scale nearly 2 mm. long, rather broad, similar in texture to the female.

Adult female tinged with yellow, long-oval, length about 2450 μ when extended; abdominal segments prominent laterally, bearing spines; pygidial area broad;

median lobes broad, sloping to a blunt point, the edges minutely dentate; second lobes consisting of two shorter rounded lobules, the first resembling the median lobes, more or less notched on each side, the second simple; third pair of lobes short and rounded, broad at base; two spines and two long spine-like plates in the wide interval between the median lobes; two spine-like plates lateral of median lobes, and three

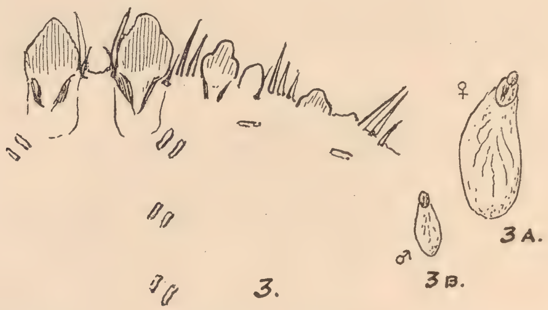

Fig. 3. *Lepidosaphes ixoræ.* 3, caudal structures; 3A, female scale; 3B, male scale.

lateral of second and of third lobes; basal margins of lobes thickened, and the whole pygidial margin dense; prominent dorsal glands, but no circumgenital glands; anal orifice small, transversely oval or nearly circular, over twice as far from hind end as first lobes are from third.

Larva in female 400 μ long; eyes blue after boiling in liquor potassæ.

Los Baños, Philippine Is., Jan. 5, 1915 (C. F. Baker, 3264). On stems of *Ixora coccinea.* The very large larvæ are evidently produced viviparously.

In Leonardi's arrangement, this will fall in *Coccomytilus,* nearest to *C. albus* (Ckll.), from which it differs by the much greater size, more prominent lobes, and the character of the scale.

The following species of Diaspinæ have lately been collected in the Philippine Is. by Professor C. F. Baker. (L. B. = Los Baños.)

Parlatoria zizyphus (Lucas). On *Citrus decumana;* L. B., Jan. 5, 1915 (3272).

P. pergandii Comstock. In the material boiled up from 3289, L. B., on *Celtis philippinensis,* we found a mature female with the characters of *P. pergandii,* but the scale was overlooked and lost, and no other *Parlatoria* scales can be found on the material. The caudolateral grouped glands were 5, cephalolaterals 6; rudimentary, pointed, fourth lobe very distinct.

Fiorinia fioriniæ (Targ.). L. B., on leaves of *Celtis philippinensis,* Jan. 15, 1915 (3289). "When crowded soon overlaid by a stratum of *Septobasidium minusculum* Syd." (Baker.)

Pinnaspis siphonodontis C. & R. L. B., on *Celtis philippinensis,* Nov., 1914 (3292).

Pseudaonidia curculiginis Green. L. B., on leaf bases of *Corypha elata,* Jan. 15, 1915 (3290).

Chrysomphalus pedroniformis C. & R. Prov. Bataan, on "Kapok"; received from Bureau of Agriculture (3675).

C. aonidum (*L.*) On a small climbing Aroid, summit of Mt. Makiling, Prov. Laguna, Nov., 1914 (3307); L. B., on *Citrus nobilis*, Jan. 15, 1915 (3300); on *Caryota*, L. B., Jan. 15, 1915 (3295).

Aspidiotus rapax Comst. On oranges received in the Manila market from Southern California, Jan. 1, 1915 (3298).

A. cydoniæ var. *greenii* (Ckll.). L. B., on *Chrysanthemum*, Aug. 30, 1914 (3109); L. B., on fruits of *Achras sapota*, Jan. 1, 1915, "abundant here, and injurious; fruits commonly completely covered," (3261).

A. translucens (Ckll.). L. B., on *Musa sapientum*, Jan. 5, 1915 (3275); L. B., on *Tamarindus indicus*, Jan. 5, 1915 (3281).

Lecaniinæ.

Platylecanium n. gen.

Female flat, broad oval, without waxy covering; antennæ small or rudimentary; legs absent; ventral surface in abdominal region with groups of pores arranged in a semicircle, in the centre of which is the anal aperture; marginal bristles small and simple. Type, *Platylecanium cribrigerum* (*Neolecanium cribrigerum*, C. & R., Bull. Amer. Mus. Nat. Hist., XXXIV, p. 110).

When *P. cribrigerum* was described as a *Neolecanium*, it was remarked that it probably deserved to rank as a distinct genus. Mr. E. E. Green has lately described a strictly congeneric species, *Platylecanium pseudexpansum* (*Lecanium pseudexpansum* Green, Bull. Entom. Research, V, 1914, p. 233) from Australia, and this seems to justify the separation of the genus. We are indebted to Mr. Green for cotypes of his species, which averages larger, and has better developed antennæ.

The following Lecaniinæ have been received from Prof. Baker, who collected them in the Philippines. (L. B. = Los Baños.)

Pulvinaria thespesiæ Green. L. B., on *Codiæum variegatum*, Aug., 1914 (3108).

P. psidii Maskell. L. B., on *Psidium guajava*, Jan. 15, 1915 (3302); L. B., on *Antidesma bunius*, Aug., 1914 (3105); L. B., on *Eugenia jambos*, Jan. 15, 1915 (3296).

Saissetia nigra (Nietner). L. B., on *Withamia origanifolia*, "cultivated here from seed," Jan. 15, 1915 (3303).

S. hemispherica (Targ.). L. B., on *Anona muricata*, or "Guanabana," "confined to edges and tips of under surfaces of leaves," Jan. 1, 1915 (3260).

Paralecanium luzonicum Ckll. Mt. Makiling, on *Tetrastigma,* Feb. 15, 1915 (3676).

Coccus elongatus (Signoret). L. B., on *Anona squamosa,* Feb. 1, 1915 (3674).

Coccus viridis (Green). L. B., on *Citrus nobilis,* Jan. 15, 1915 (3301); L. B., on *Citrus decumanus* (3279); L. B., on *Antidesma bunius* (3276); L. B., on *Gardenia florida,* Jan. 30, 1915 (3628).

Dactylopiinæ.

Pseudococcus virgatus (*Cockerell*).

Los Baños, Philippine Is., Jan., 1915, collected by Prof. Baker on *Graptophyllum* (3265), *Codiæum variegatum* (3267), *Cæsalpinia pulcherrima* (3266), *Spondias,* "often covering whole plant" (3262), and *Xanthosma sagittifolium,* "occurring in extensive masses, principally on petioles" (3268).

Asterolecanium pustulans (*Cockerell*).

On *Bauhinia,* Bahia, Brazil (Tavares, 299).

Monophlebinæ.

Icerya seychellarum (*Westwood*).

Los Baños, Philippine Is., on *Citrus decumana,* Jan. 30, 1915 (Baker, 3629).

56.(1181:78.7)

Article XIV.— A REVISION OF THE LOWER EOCENE WASATCH AND WIND RIVER FAUNAS.

By W. D. Matthew and Walter Granger.

PART IV.— ENTELONYCHIA, PRIMATES, INSECTIVORA (PART).

By W. D. Matthew.

Order ENTELONYCHIA.

Fam. ?ISOTEMNIDÆ.

Arctostylops steini gen. et sp. nov.

Plate XV.

Molar pattern much as in *Notostylops*, but crowns much higher and narrower, heel longer, trigonid more reduced. P_4 submolariform, P_3 nearly simple, trenchant. Size minute, p_3–m_3 = 18 mm.

Lower Gray Bull beds, Clark Fork basin, Wyoming.

Type, No. 16830, a lower jaw with p_3–m_3 perfect and unworn.

The discovery of a Notoungulate mammal in the North American Eocene was so completely unexpected that the evidence requires critical sifting before acceptance.

In order first to verify the discovery and to exclude the possible suggestion that the specimen might have been secured by Mr. Stein when with Dr. Loomis's expedition to Patagonia a few years earlier, and by some accident mislaid and subsequently mixed up with his Bighorn basin collection, I obtained from him and from his assistant Mr. Turner detailed accounts of the exact locality and circumstances of the discovery. While it is unnecessary to spread these letters upon the record they are sufficient to render it absolutely certain that no such confusion occurred, that the specimen here described and figured was found by Mr. Stein in the upper part of the Wasatch exposures of Clark Fork basin.

It will be obvious that the teeth bear no resemblance to any northern group of mammals, living or extinct. They are not of a primitive but of a highly specialized type. There is one and only one of the larger groups of mammals which shows in multiform variations this peculiar fundamental pattern in the molars. This is the Notoungulata, including under that name a number of orders and suborders of extinct mammals, the Toxodontia, Typotheria, Astrapotheria, Entelonychia, Litopterna, all peculiar to South America. Amid endless variations in size proportions and specializations of one kind or another, all of these animals show in the fundamental molar pattern certain peculiarities not found in any of the many parallel adaptations among other mammals. There are certain characteristics in the lower dentition common to all these South American Tertiary ungulates and unknown to any of the Holarctic orders. The most distinctive of these

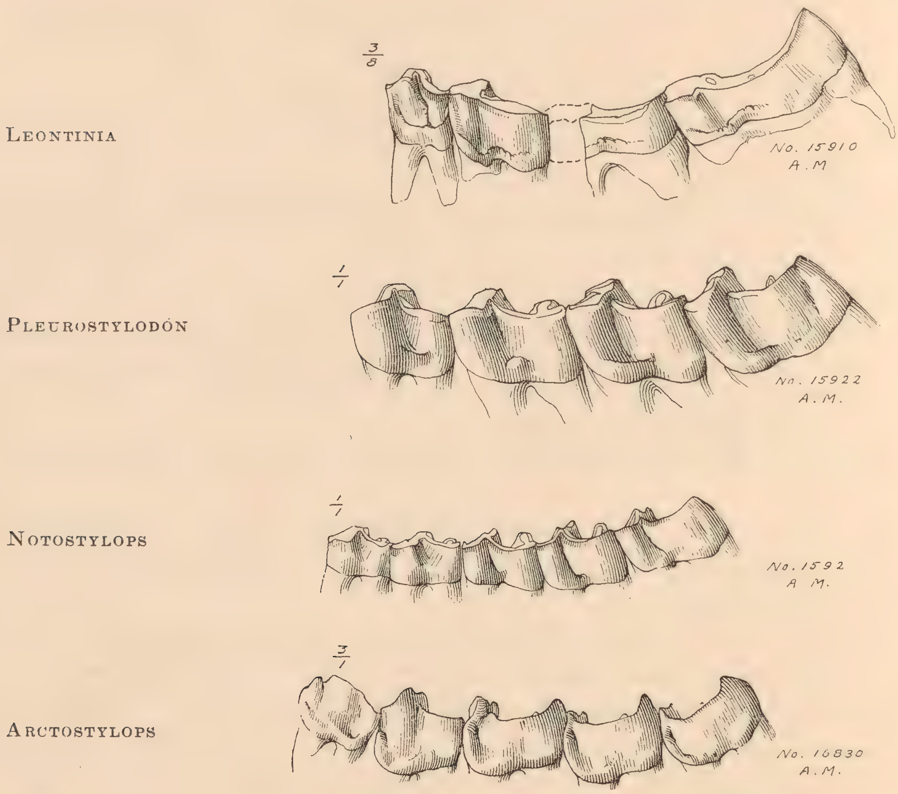

Fig. 1. *Arctostylops steini*, type specimen, compared with South American Entelonychia. Outer views of lower teeth.

is the cusp which rises in the middle of the talonid, branching off from its outer wall which forms a high curving crest. The construction is described by Schlosser[1] as follows:

"Die unteren M bestehen aus je zwei äusseren Halbmonden von denen der vordere viel kürzer ist als der hintere, und aus zwei mehr oder weniger komprimierten Innenhöckern gebildet wird, von welchen sich der vordere mit dem Hinterende des ersten Halbmondes innig verbindet, während der

[1] Zittel's Grundzüge der Palæont., Vertebrata, Ed. 1911, p. 512.

hintere dem zweiten Halbmond gegenüberliegt und häufig gänzlich isoliert bleibt."

The construction in Entelonychia he further defines as[1] "Untere M mit einem sehr kurzen vorderen und einem langgestreckten hinteren Halbmond und zwei Innenhöckern, von denen der erste stark in die Quere gezogen ist."

These descriptions apply accurately to the specimen in hand. It is not so readily placeable in any of the South American families. It represents an extreme type of reduction of the anterior, and elongation of the posterior crescent, high and narrow crown, and simple premolars. The Isotemnidæ appear to be nearest, although the genera are decidedly more brachyodont and the disproportion of the crescents is less. There is in

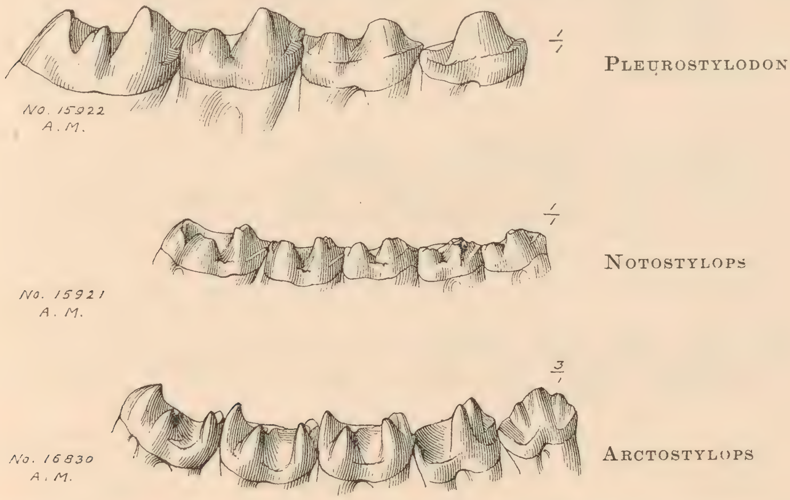

Fig. 2. *Arctostylops steini*, type specimen, compared with South American Entelonychia. Inner views of lower teeth.

these features a strong suggestion of nearer relationship to *Leontinia*, despite the contrast in size, but I think it is probably illusory. At all events there appears to be no known South American genus with which it compares closely. I suspect that when better known it will prove to stand in the same relation to the Entelonychia as does *Metacheiromys* to the Loricata,— an aberrant offshoot from a primitive stage in their evolution. It has much nearer allies in the South American faunæ than has *Metacheiromys*. But this may be because we are able to compare it with Eocene types (Notostylops fauna), while our comparisons of *Metacheiromys* with the armadillos are limited to Miocene (Santa Cruz fauna) and later types, nothing being known of the skeleton of the older armadillos. Between

[1] L. c., p. 521.

Arctostylops and the *Isotemnidæ* there is no very wide gap in time; between the Palæanodonts (Metacheiromyidæ) and the Loricates there is a very wide gap, sufficient for a great deal of divergent evolution.

The interpretation of this discovery depends upon the interpretation of the occurrence of *Metacheiromys.* If the latter be regarded as a relict of a formerly northern distribution of the Edentata, the same explanation will apply to *Arctostylops.* If it be regarded as an immigrant from South America, then this little Homalodothere may have arrived in the same way. A thorough revision of the Paleocene faunæ with the new material recently acquired may enable us to recognize possible or probable sources for the

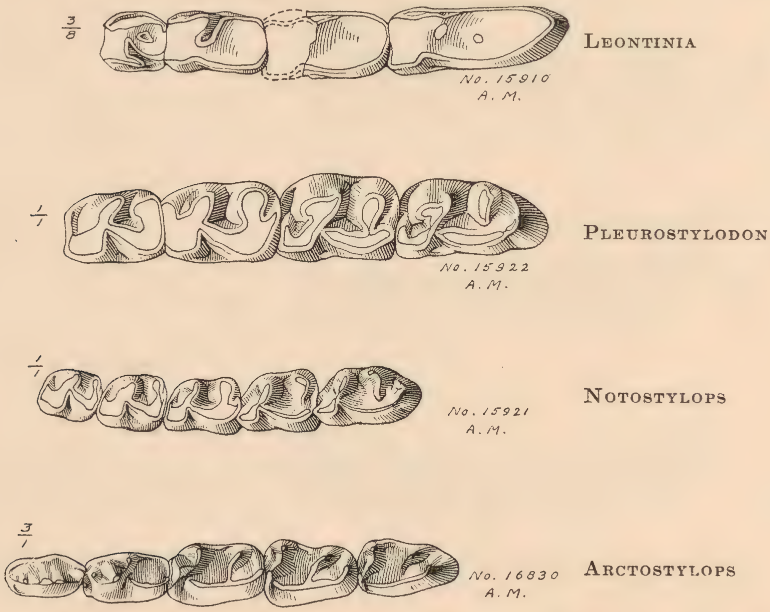

Fig. 3. *Arctostylops steini*, type specimen, compared with South American Entelonychia. Crown views of lower teeth.

South American faunæ, the oldest of which, that of the Casa Mayor horizon, is regarded by Schlosser as probably Middle or Upper Eocene. Schlosser's opinion on this point is entitled to especial respect as he has obtained and studied large collections from the older Tertiary horizons of Patagonia. Professor Scott, in his recent volume, regards the fauna as Eocene, but does not attempt any more precise correlation. I had formerly (1902) regarded the Notostylops fauna as Paleocene, but further consideration of the faunal evidence led me to place it later, and I am now disposed to agree with Dr. Schlosser's estimate. If this correlation be correct, we may find among the unspecialized trituberculate placentals of the Paleocene faunæ types which will serve as a source for the various specialized groups peculiar to the South American Tertiary. But we cannot consider the latter as directly derived from our Paleocene faunæ, as in both Puerco and Torrejon horizons we find a large and diversified element of Creodonta, which is absent from the South American faunæ where carnivorous marsupials take its place.

The reference of a mammal from our lower Eocene to this distinctively South American group will naturally appear questionable to many palæontologists, especially since the evidence rests at present only upon a lower jaw. Were the pattern a primitive and generalized one or were the resemblance in superficial or adaptive characters of the teeth I should regard it as inadequate. But the agreement lies not in superficial resemblances but in the peculiar fundamental pattern of the molar teeth which is the principal reason for regarding these South American ungulates as related to each other and distinct from the northern groups. If *Arctostylops* is not a member of this southern group, we must conclude that this peculiar pattern has also arisen independently in some northern group of mammals. This would be a somewhat remarkable coincidence indeed, but not inconceivable, and tenable were there sufficient evidence that the genus was not related to the Notoungulates. But I can find nothing in the teeth or jaw characters that would afford a reason against reference to the Entelonychia. It may indeed be difficult to reconcile with certain hypotheses of the time and place of origin and evolution of these South American placentals. That is an excellent reason to verify and sift the evidence critically; it is hardly a reason for rejecting it.

Order PRIMATES.

The two families here referred to the order, the Adapidæ (including Notharctidæ as a subfamily) and Tarsiidæ (Anaptomorphidæ) are Primates beyond reasonable question. Some or all of the genera of the families Apatemyidæ and Mixodectidæ, here placed as Insectivora, may when better known have to be transferred to the Primates. This is true especially of *Trogolemur* in the former and of *Cynodontomys* and *Microsyops* in the latter family, in which the dentition, save for the double-rooted upper canine of *Microsyops*, is of a type very like the known Eocene primates.

Family ADAPIDÆ.

[1]*Pachylemuridæ* Miall 1875, Filhol 1876.

Adapidæ Trouessart 1879, Revue et Magaz. de Zool. 3e ser. t. vii, p. 223; Cope 1885, Amer. Nat., Vol. XIX, p. 459; Wortman 1903, Amer. Journ. Sci., Vol. XV, p. 174; Schlosser 1911, in Zittel's Grundz. d. Pal., Vertebrata, p. 546.

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[1] Not available because not based on a genus.

Notharctidæ TROUESSART 1879 l. c.; OSBORN 1902, Bull. A. M. N. H., Vol. XVI, p. 190; STEHLIN, 1912, Abh. d. schw. pal. Ges., Vol. XXXVIII, p. 1287.

Notharctus and its relatives in the American Eocene are considered as a distinct family by some authorities, as a subfamily of the Adapidæ by others. Doctor Stehlin in his recent monographic study of *Adapis* specifies a series of important distinctions in the character and evolutionary trend of the two groups and concludes that they are distinct. In addition to a series of less fundamental distinctions he points out that the hypocone in the upper molars originates in the Notharctid phylum by budding off from the protocone, whereas in the Adapidæ he believes that it is certainly a derivative from the cingulum. Doctor Gregory's morphologic studies of the skulls and skeletons of *Notharctus* and its relatives indicate, however, a somewhat nearer affinity to *Adapis,* so that the two may be considered as divergent phyla of a single family. The reasons for this conclusion will be set forth by him in other articles in this Bulletin. They tend moreover to emphasize the lemuroid affinities of the family, upon which most authorities, with the exception of Dr. Wortman, are agreed.

Three or more genera of Notharctidæ accur in the Middle Eocene formations. In the Lower Eocene formations there are two, *Pelycodus* characterizing the earlier horizons, *Notharctus,* typically from the Middle Eocene (Bridger) but represented by primitive species from the Wind River (Lost Cabin beds). The two genera are successive stages of a single phylum and are distinguished as follows:

Notharctus Leidy: Hypocone and mesostyle of upper molars prominent.

Pelycodus Cope: Hypocone and mesostyle rudimentary or absent.

The species of Notharctidæ from successive horizons of lower and middle Eocene, from the Sand Coulée to the upper Bridger illustrate very clearly the progressive change in the upper molars from tritubercular to fully quadritubercular type, the development of the mesostyle, the complication of the fourth premolar and increase in size. This was pointed out by Osborn in 1902,[1] and is confirmed and extended by the much larger series of specimens and exact records of horizons now at hand for comparison. They are very good horizon markers. As with other abundant groups, a large series shows a certain range of individual variation, some being more and others less progressive, but within comparatively narrow limits. As we progress upward through successive levels of the formations, we find that the limits of individual variation, on one side and the other of the abundant typical forms, are progressively shifted over in the direction of the phyletic trend. That this is a gradual shifting of averages, due to the

[1] Osborn, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 191.

disappearance of less progressive individuals, and appearance and increase of more progressive individuals, seems to be fairly well shown in this phylum and in the *Cynodontomys-Microsyops* phylum, less clearly in some others. It is not the gradual replacement of one species by another distinct and more progressive species, but so far as one may judge from the characters of the teeth the gradual conversion of one species into its successor by the progressive elimination of the more primitive and increase in numbers of the more advanced individuals. The detailed geologic record of these phyla appears therefore to afford direct proof of continuity in their evolution. In the Hyopsodontidæ, as I have pointed out, it is not so precisely continuous, but appears to be rather the gradual replacement of one species by a more advanced one.

Pelycodus *Cope*, 1875.

Type, Prototomus jarrovii Cope 1874, from the Wasatch of New Mexico.

The genus is distinguished from *Notharctus* by the substantially tritubercular upper molars. The lower teeth are practically indistinguishable in approximating species of the two genera. The species increase progressively in size through the Lower Eocene, but small species likewise appear in the later levels, distinguished from those of the earlier horizons by their more progressive character. The first appearance of the phylum in the known Tertiary succession is in the Sand Coulée beds (*P. ralstoni*) at the base of the Wasatch. The skeleton construction of this species is unknown, but in the next stage (*P. trigonodus* of the Lower Gray Bull) we have associated [1] skeleton bones which show that the peculiar and characteristic structure and proportions of the limb and foot-bones, especially of astragalus and calcaneum, was as fully developed as in the latter Notharctidæ.

There are several Paleocene genera which might be regarded as ancestral or related to *Pelycodus* on evidence of their teeth alone. But as yet no trace of the characteristic skeleton bones of Primates has ever been found in the Paleocene, and some of the Paleocene genera which are closest to them in dental characters (*e. g. Chriacus*) are known to be entirely different in skeleton, and to pertain not to the Primates but to Creodonta, Condylarthra and Insectivora.

As the evidence stands therefore we must regard the Notharctidæ as an immigrant family at the base of the Wasatch.

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[1] *i. e.*, known to belong to the same individual as the jaws with which they are found.

Key to Species of Pelycodus.

I. Paraconids distinct on m_{1-3}

1. $M_{1-3} = 11–14$ mm. Upper molars trigonal to sub-quadrate; no hypocones *P. ralstoni.*

II. Paraconids vestigial on m_{2-3}, distinct on m_1

2. $M_{1-3} = 14–16$ mm. No hypocone on upper molars, inner cusp of p_4 weak *P. trigonodus.*
3. $M_{1-3} = 14–16$ mm. Hypocone on m^{1-2}, obscure to distinct, inner cusp of p_4 strong..*P. frugivorus.*
4. $M_{1-3} = 16–18$ mm. Hypocone on m^{1-2}, obscure to distinct, inner cusp of p_4 strong..*P. jarrovii.*

III. Entoconid placed more anteriorly than in other species and connected by a crest with metaconid.

5. $M_{1-3} = 19$ mm. ....*P. tutus.*

Pelycodus ralstoni sp. nov.

Type, No. 16089, upper jaw with p^4–m^3, from Sand Coulée zone (basal Wasatch) in Clark Fork basin, Wyoming.

Distinctive characters: $M_{1-3} = 11–14$ mm. p_4 smaller and less compressed than in *P. trigonodus;* upper molars more triangular, of less anteroposterior length.

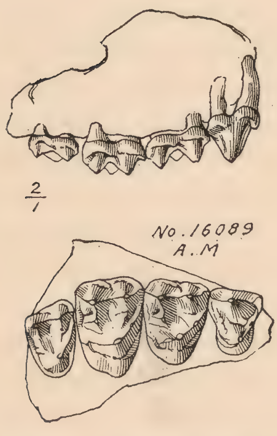


Fig. 4. *Pelycodus ralstoni*, upper jaw, external and crown views. Type specimen, Sand Coulée beds, Clark Fork basin, Wyoming.

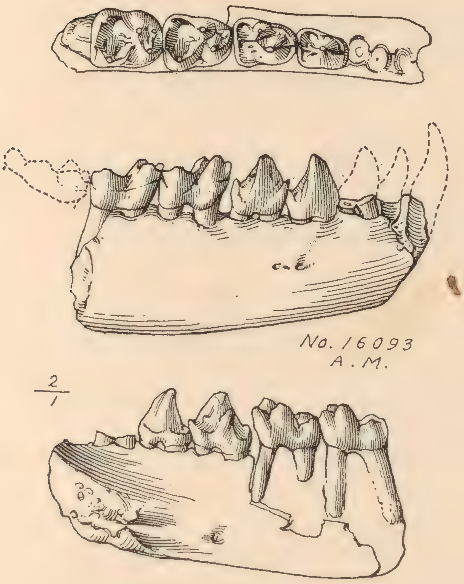
This species is considerably smaller than the others, the anteroposterior diameters of the teeth notably less, the premolars smaller in proportion. The protocone is not broadened posteriorly as it is in *P. trigonodus.*

Some thirty specimens from the Sand Coulée beds in Clark Fork basin agree more or less exactly with the type. A dozen specimens from Shoshone River and a few from other localities low down in the Gray Bull also belong here. A few are intermediate between *P. ralstoni* and *P. trigonodus.*

Pelycodus trigonodus sp. nov.

Type, No. 15017, upper and lower jaws, from the lower part of the Gray Bull horizon, 5 miles south of Otto, Wyoming.

Distinctive characters: $M_{1-3} = 15$ mm. No hypocone on upper molars. P_4 with small metaconid, more compressed than in *P. frugivorus.*



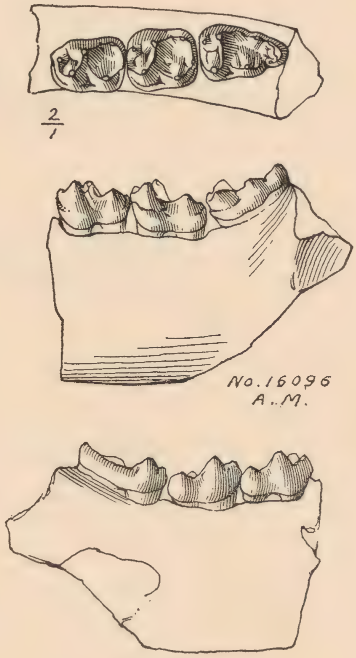


Fig. 5. Fig. 6.

Fig. 5. *Pelycodus ralstoni*, inner, outer and crown views of lower jaw fragment. Sand Coulée beds, Clark Fork basin, Wyoming.

Fig. 6. *Pelycodus ralstoni*, inner, outer and crown views of lower jaw fragment. Sand Coulée beds, Clark Fork basin, Wyoming.

To this species are referred a large number of jaws and jaw fragments from the same horizon as the type.

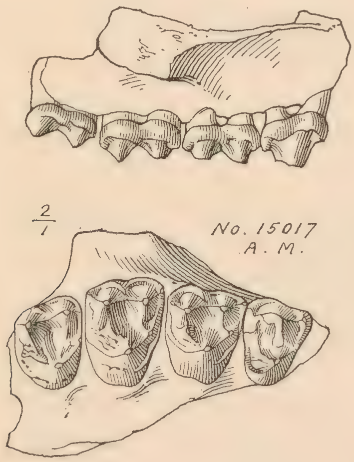


Fig. 7. *Pelycodus trigonodus*, upper jaw of type specimen, outer and crown views. Gray Bull beds, Bighorn basin, Wyoming.

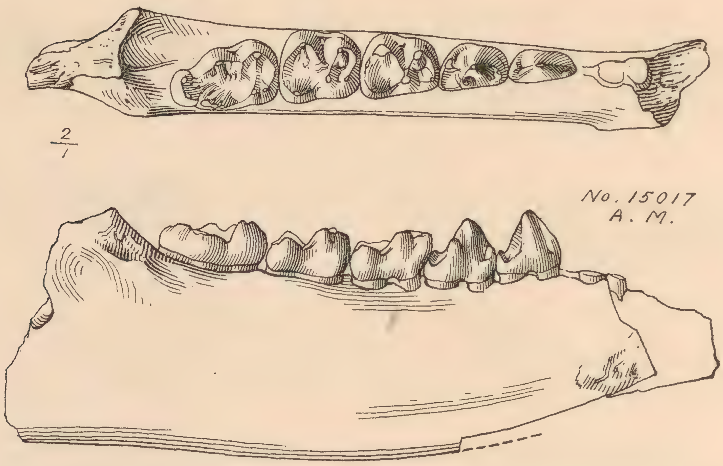


Fig. 8. *Pelycodus trigonodus*, lower jaw of type specimen, inner and crown views. Gray Bull beds, Bighorn basin, Wyoming.

Although the hypocone is absent, the protocone is broader anteroposteriorly than in *P. ralstoni*, giving the molar a more quadrate form approaching that of *P. jarrovii.*

Pelycodus jarrovii (*Cope* 1874).

Prototomus jarrovii Cope, 1874, Rep. Foss. Vert. New Mex., p. 14; (*Pelycodus*) 1875, Syst. Cat. Eoc. New Mex., p. 13; (*Tomitherium*) 1877, Ext. Vert. New Mex., p. 137, pl. xxxix, figs. 17–18.

Pelycodus jarrovii, *P. frugivorus* in part, Osborn, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 193, fig. 20A.

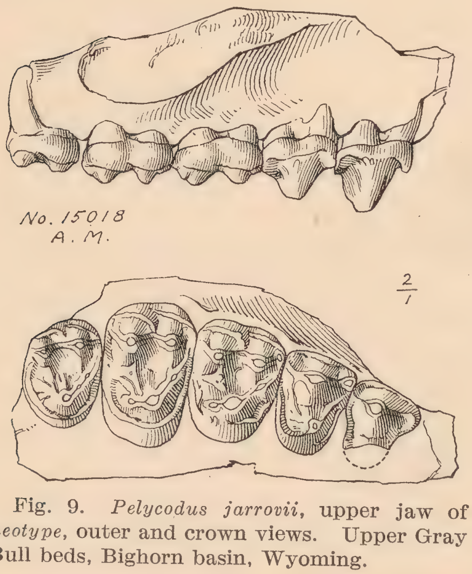


Fig. 9. *Pelycodus jarrovii*, upper jaw of *neotype*, outer and crown views. Upper Gray Bull beds, Bighorn basin, Wyoming.

The type of this species is a lower jaw fragment with m_{2-3} from the Wasatch of New Mexico. Probably it is the specimen figured by Cope in 1877, fig. 17 of pl. xxxix. The skeleton parts figured on pl. xl, figs. 1–15, do not belong to the teeth with which they were associated (fig. 18 of pl. xxxix) but are the bones of a Creodont.

In the American Museum collection from the New Mexican Wasatch there is but one specimen referable to this species, a jaw fragment, No. 16298, with m_{2-3} from the lower (Almagre) beds. In the Lysite and upper levels of the Gray Bull beds in Wyoming the common form of *Pelycodus* is indistinguishable from *P. jarrovii*. Some forty specimens are referable from the upper Gray Bull,

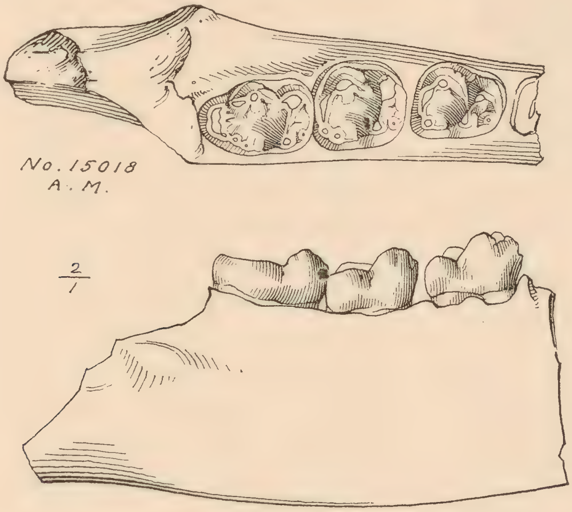


Fig. 10. *Pelycodus jarrovii*, lower jaw of *neotype*, inner and crown views. Upper Gray Bull beds, Bighorn basin, Wyoming.

ten or twelve from the Lysite of the Bighorn, and two or three from the Lysite of Wind River basin. In the absence of adequate topotypes I designate as *neotype* No. 15018, associated upper and lower jaws from the upper Gray Bull, Head of Dorsey Creek, Bighorn basin.

The species is confined to these upper levels, except for a single specimen, No. 15029, recorded as from 5 miles south of Otto, which would bring it low down in the Gray Bull.

Pelycodus frugivorus *Cope.*

Pelycodus frugivorus Cope, 1875, Syst. Cat. Eoc. Vert. New Mex., p. 14; (*Tomitherium*) 1877, Ext. Vert. New Mex., p. 144, pl. xxxix, fig. 16; 1885, Tert. Vert., p. 230 (Bighorn specimens only).

The type of *P. frugivorus* is a jaw fragment with m_{2-3} from the New Mexican Wasatch, horizon unknown. There are several parts of jaws in our New Mexican collections which agree well enough in size and characters with Cope's figures and description, but they vary considerably among themselves, and some are from the lower, some from the upper horizon. No. 16209, a jaw fragment with m_{2-3}, from the upper beds agrees most nearly, although slightly larger. This in turn agrees rather closely with *P. nunienus,* founded by Cope in 1887 on a lower jaw from the Lost Cabin beds. Cope in 1885 referred this Wind River species and also several jaws from unknown levels in the Bighorn basin to *P. frugivorus.* Osborn in 1902 retained the Bighorn specimens in *P. frugivorus* but separated *P. nunienus* and referred it to *Notharctus.*

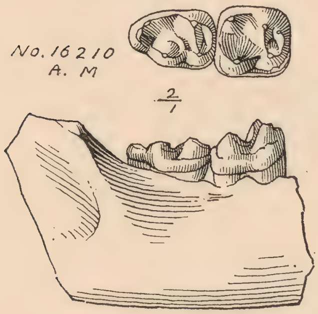


Fig. 11. *Pelycodus frugivorus,* lower jaw fragment, outer view and crown of teeth. Upper (Largo) beds of Wasatch, San Juan basin, New Mexico.

It is certain that two and probable that three different species have been included under *frugivorus.* Specimens from the lower Gray Bull horizon have no hypocone on the upper molars; in those from the Lost Cabin it is very prominent. There is indeed no certainty as to which form is cospecific with the type of *P. frugivorus;* but as the fauna of the lower beds of the Gray Bull seems to be older than any of the New Mexican Wasatch, I think it unlikely that the *Pelycodus* of this horizon is identical with Cope's type; and if the latter came from the upper beds, as No. 16209 may indicate, it is much more likely to be identical with *P. nunienus* or to be a primitive mutant of it. Loomis in his review of the Wasatch and Wind River primates noted differences between the Wasatch and New Mexican speci-

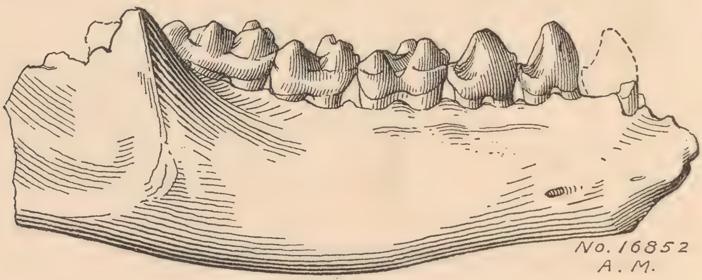


Fig. 12. *Pelycodus frugivorus,* lower jaw, outer view. M_{2-3} are drawn from a second specimen found in association. Upper Gray Bull beds, Bighorn basin, Wyoming.

mens of *P. frugivorus* to which he assigned varietal value. It appears best on the whole to assign to *P. frugivorus* the specimens from Upper Gray Bull and Lysite horizons, and regard *nunienus* as a more progressive species which falls into the genus *Notharctus,* as does *N. venticolus* in the larger series. The specimens from the Lower Gray Bull I have distinguished as *P. trigonodus.*

To *P. frugivorus* may be referred No. 15625 and other specimens from

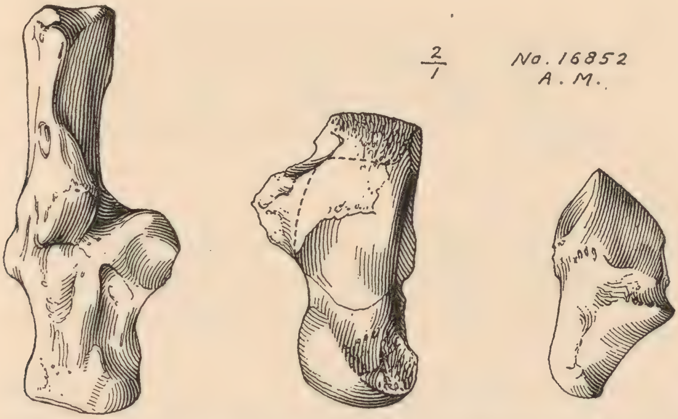


Fig. 13. *Pelycodus frugivorus*, calcaneum, astragalus and entocuneiform of the right side, all front views. Found associated with lower jaw, No. 16852 (Fig. 12). Upper Gray Bull beds, Bighorn basin, Wyoming.

the Lysite and Upper Gray Bull in which the lower molars are from 14–16 mm. In these specimens the inner cusp of p_4 is strong, the tooth stout and oval; the hypocone is present on m^{1-2} but varies from obscure to distinct. In these and other features it agrees with *P. jarrovii;* I can find no distinctions except the smaller size and less robust proportions.

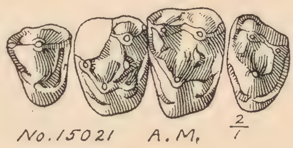


Fig. 14. *Pelycodus frugivorus*, upper teeth, crown view. Upper Gray Bull beds, Bighorn basin, Wyoming.

Pelycodus tutus (*Cope*).

Tomitherium tutum Cope, 1877, Ext. Vert. New Mex., p. 141, pl. xxxix, fig. 19. Not pl. xl, figs. 16–25. Not *Pelycodus tutus* Cope, 1885, Tert. Vert., p. 228, pl. xxva, figs. 1–3.

Type, a lower jaw fragment with m_{2-3} from the New Mexican Wasatch.

Distinctive characters: $M_{1-3} = 19$ mm. Entoconid placed more anteriorly than in other species and connected by a crest with the metaconid.

This species is clearly distinguished from any other by the characters cited. Nos. 16205–7, lower jaws from the upper horizon (one from the top of the lower beds) of the New Mexican beds are referred here. The species has not been found in Wyoming and its upper teeth are unknown.

Notharctus *Leidy* 1870.

Type, N. tenebrosus from the Lower Bridger, Wyoming.

Distinctive characters: Hypocone prominent, well distinguished from protocone and more or less nearly equal to it; mesostyle clearly distinct.

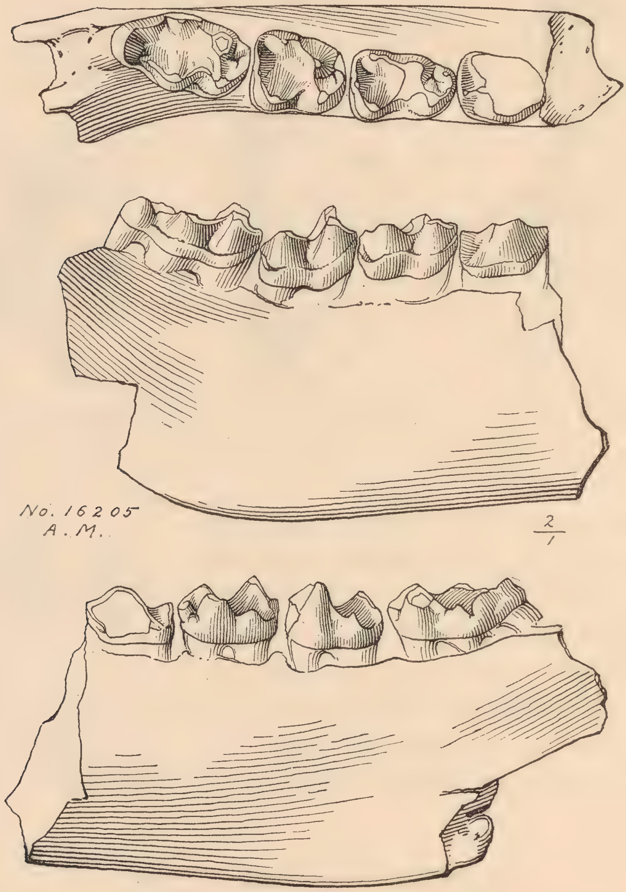


Fig. 15. *Pelycodus tutus*, lower jaw, inner, outer and crown views. Top of lower (Almagre) beds of Wasatch, San Juan basin, New Mexico.

Osborn in 1902 distinguished *Notharctus* from *Pelycodus* by the above characters, and showed that *P. nunienus* Cope and *P. venticolus* Osborn of the Wind River were referable to the Bridger genus. They are distinguished from most of the Bridger species by the symphysis of the jaw, which is in no instance coössified. One small Bridger species retains this primitive character but it is lost in all the others. The two species from the Lower Eocene are from the Lost Cabin horizon, and are separable from each other chiefly by size, although the larger species is the more progressive. I regard them as progressive stages of *Pelycodus frugivorus* and *P. jarrovii* respectively.

The three species referred by Loomis to *Notharctus* do not appear to me to pertain to that genus. *N. palmeri* and *N. cingulatus* I refer to *Cynodontomys latidens; N. minutus* appears to be a small *Omomys.*

Notharctus venticolus *Osborn* 1902.

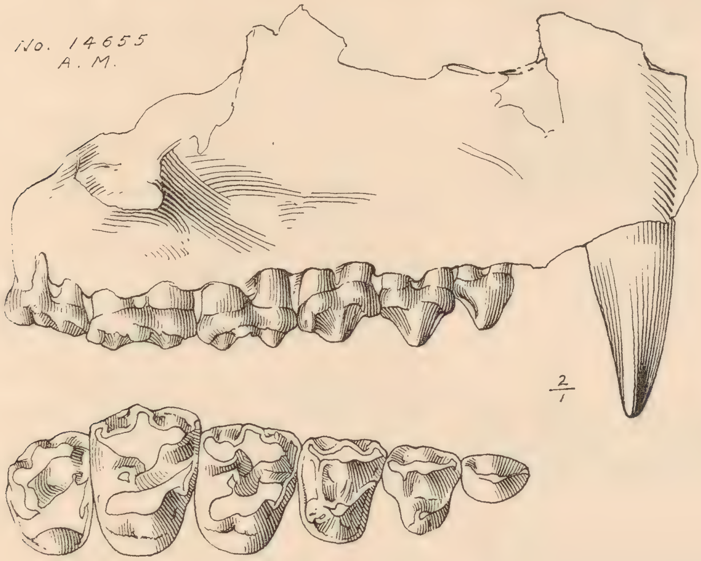


Fig. 16. *Notharctus venticolus*, maxilla, outer view, and crown view of teeth. Lost Cabin beds, Wind River basin, Wyoming.

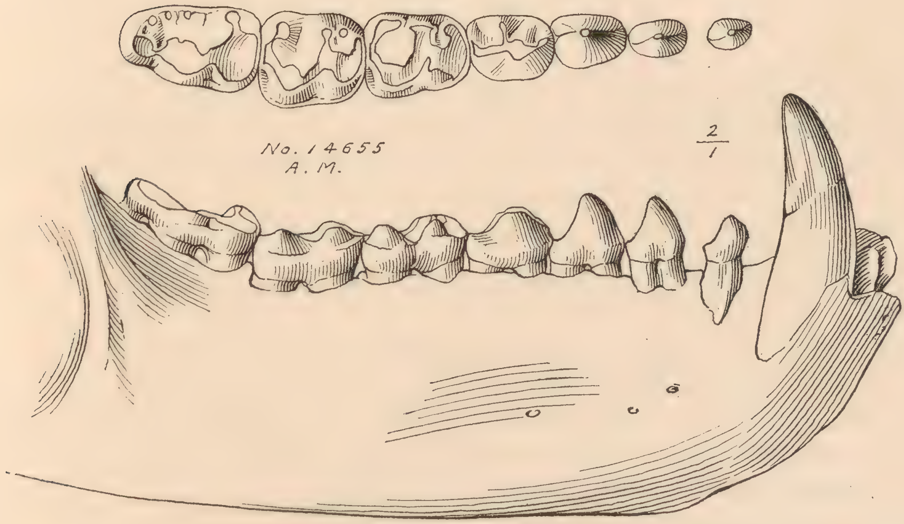


Fig. 17. *Notharctus venticolus*, lower jaw, outer view and crown view of teeth. Associated with maxilla shown in Fig. 16. Lost Cabin beds, Wind River basin, Wyoming.

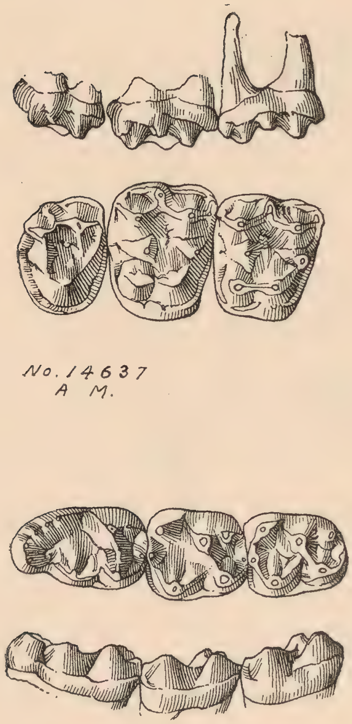


Fig. 18. *Notharctus venticolus*, upper and lower molars, slightly worn outer and crown views of each series. Lost Cabin beds, Wind River basin, Wyoming.

Pelycodus tutus Cope, 1885, Tert, Vert., p. 228, pl. xxva, figs. 1–3. Not *P. tutus* Cope, 1877. *Notharctus venticolus* Osborn, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 195.

Type, No. 4715b, parts of upper and lower jaws, from the Lost Cabin zone in the Wind River basin, Wyoming.

Distinctive characters: $M_{1-3} = 18$ mm.; symphysis of jaw not coössified.°

Referred specimens, Nos. 4726, 4728, 14637, 14638, 14640, 14655–6, etc. The best of these specimens is a fairly complete skull and jaws, No. 14655, the teeth of which are here figured.

The larger size sufficiently distinguishes this species from *N. nunienus*. Most of the referred specimens are larger than the type. Comparison with the Bridger genera and species is difficult, as they have not been revised. Some of these later species show a rudimentary metacone (tritocone) on p^4, a character not observed in any Lower Eocene Notharctid. The two Wind River species are likewise primitive in the sutural symphysis mandibuli, which is coössified in most of the Bridger species.

Notharctus nunienus (*Cope*).

Pelycodus nunienus Cope, 1881, Bull. U. S. Geol. Geog. Surv. Terrs., Vol. VI, p. 187; (*P. frugivorus*) 1885, Tert. Vert., p. 230 (Wind River specimens only) pl. xxva, figs. 4–5; *Notharctus nunienus* Osborn, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 195, fig. 22.

Type, No. 4734, lower jaw with p_3–m_3r. from Lost Cabin beds of Wind River basin, Wyoming.

Distinctive characters: $M_{1-3} = 15$ mm.; heel of m_3 bicuspid; symphysis of jaw not coössified.

To this species are referred a number of jaws and jaw fragments from the Lost Cabin beds. It is a little larger than *P. frugivorus* and distinguished by the more strongly developed hypocones — not as strong, however, as in *N. venticolus*. The species would be considered a mutation of *frugivorus* except that the one is referable to *Notharctus* and the other to *Pelycodus* according to the distinctions established by Osborn.

No. 4735, upper jaw, 4736, 15603, 12736 lower jaws, and other more fragmentary specimens are referable to this species. All are from the Lost Cabin horizon in the Wind River basin.

Family TARSIIDÆ.

The revision of the so-called Anaptomorphidæ of the Lower Eocene is exceptionally difficult. They are all of minute size, the material is mostly very fragmentary, and comparatively scarce, and the number and diversity of genera and species appears to have been very considerable. Except for a skull, Amer. Mus. No. 4194, found by Wortman in the Bighorn basin and referred by Cope to *Anaptomorphus,* they are known only from upper

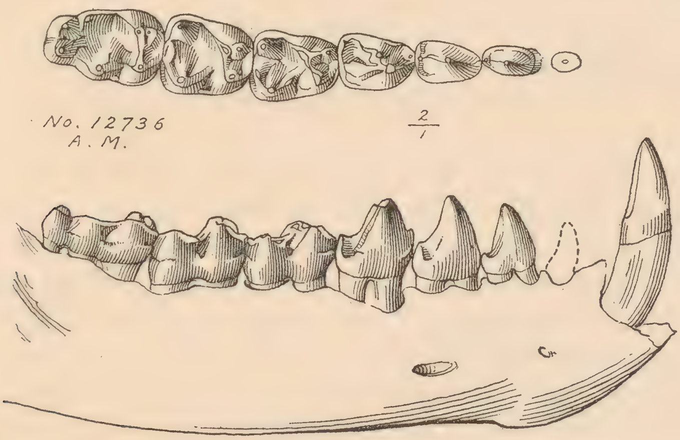


Fig. 19. *Notharctus nunienus*, lower jaw, outer view and crown view of teeth. Lost Cabin beds, Wind River basin, Wyoming.

and lower jaws more or less fragmentary. The Middle Eocene genera, although not quite so rare, are also known only from upper and lower jaws. No skeleton parts have been found associated. Various isolated skeleton bones of Tarsiid type, and a part of a skeleton from the Upper Bridger probably referable to *Hemiacodon,* confirm to some extent the reference to the Tarsiidæ based upon the characters of the above mentioned skull and the general resemblances in dentition. But the affinities and inter-relationship of most of the genera placed under this family must remain somewhat provisional. The Middle Eocene genera and species of this family were very ably and thoroughly revised by Dr. Wortman in 1904, upon the basis of the Yale collection from the Bridger formation. Our additional and somewhat more complete material from this formation has made it necessary, however, to modify some of his conclusions. It appeared advisable therefore to include the Middle Eocene genera in this revision.

I can find no basis for family separation from *Tarsius* of this group of Eocene lemuroids. Wortman[1] separates the modern genus "because of the modification of its hind limbs and other modernized characters." But I cannot find that he had any evidence in regard to the construction of the hind limbs in any of the Eocene genera, and our material shows that in at least one of them, probably *Hemiacodon*, the hind limbs were very like those of *Tarsius*, although less specialized. The same is true of *Necrolemur*,[2] which Wortman places in the Anaptomorphidæ. There are several characters in addition to the larger braincase in which the skull of *Tarsius* is more modernized than that of the Lower Eocene "*Anaptomorphus*." But in some other genera of this group the dentition is much nearer to *Tarsius*, and the skull construction may likewise have been nearer. In any case, the differences which can be cited are not as wide or fundamental as those between Tertiary and modern genera which no one thinks of separating into distinct families.[3] The affinities of the group and the relationships of *Necrolemur* and other European genera will be more fully discussed by Dr. Gregory.

Interrelationship of the Eocene genera. So far as the dentition indicates, these genera fall into four groups. The first including *Omomys* and *Hemiacodon* is characterized by slender jaw, semi-procumbent front teeth, i_1 and c_1 somewhat enlarged, lower premolars not crowded, p_4 triangular at base, lower molars with small trigonid, paraconid median, last molar unreduced. In the second, including *Washakius* and *Shoshonius*, the jaw is short and moderately deep, the front teeth nearly vertical, both incisors small, canine of moderate size, lower premolars somewhat crowded, p_4 with quadrate base, lower molars with an extra cusp (metastylid) on the postero-external angle of the trigonid, paraconid median on m_{2-3}, last molar unreduced. In the third group including *Uintanius* alone, the jaw is short and deep, front teeth not fully known but apparently small and more or less vertical, premolars crowded and p_{3-4} enlarged blade-like, molars with low crowns, median paraconid, last molar unreduced. The trigonids of the molars are peculiar in having the metaconids set further back than the protoconids instead of nearly opposite. The fourth group includes *Tetonius* and *Absarokius* and is distinguished by short deep jaw; one or two front teeth enlarged, more or less vertical; premolars crowded, p_{3-4} enlarged, turgid; molars exceptionally short and wide with paraconids internal and connate with metaconids, last molar much reduced. The enlarged premolars in this

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[1] Wortman, 1904, Amer. Jour. Sci., Vol. XVII, p. 28.

[2] Schlosser, 1907, Neues Jahrb., Festb., s. 197–226, taf. x.

[3] Compare for instance the range of diversity in dentition among modern Mustelidæ, or the differences between Oligocene and modern Canidæ.

group are of wholly different form from those of *Uintanius*, robust, turgid, blunt-pointed instead of blade-like and crested. *Anaptomorphus* (= *Euryacodon*) is difficult to place among these groups; its affinities are probably nearest to the fourth group, but if better known it might represent a fifth distinct phylum.

In *Tarsius* the jaw is of moderate length, the lower molars are most like those of *Omomys* but without inner cusp on p_4 and paraconids less median, the canine is somewhat larger and there is but one very small incisor not procumbent. It is not a derivative of any one of these Eocene genera.

Nor do any of the Eocene genera show any especial evidence of affinity to *Necrolemur*. In this genus the paraconid is absent on m_{2-3}, the premolars are most like those of the Omomyinæ, the interpretation of the three teeth in front of p_2 is disputed. Apparently it cannot be descended from any of the American Eocene genera. The quadritubercular upper molars readily distinguish it from all of them, and the skull characters indicate that it is not nearly related to *Tarsius*.

In default of skulls or skeletons the reference of these genera to the Tarsiidæ is of course provisional. The four groups above distinguished may represent distinct families or subfamilies but the evidence is insufficient to define them properly. Wortman's division into Omomyinæ and Anaptomorphinæ does not appear to be warranted; the first is doubtless a natural group but its rank is questionable; the second is an artificial assemblage, as Dr. Wortman himself recognized, and if the Omomyinæ are retained the remaining genera should be split up into three or four corresponding groups, *Necrolemur* being removed from the family. But pending a better knowledge of the various genera it is inadvisable to arrange them under subfamilies.

Key to Genera of Tarsiidæ.

(Lower jaw characters.)

I. Paraconids distinct, internal metaconids opposite protoconids. No metastylids. M_3 unreduced. One small incisor, canine of moderate size. Front teeth subvertical. Three small premolars with triangular bases, no deuteroconid. Jaw of moderate depth anteriorly . . . . *Tarsius*.

II. Paraconids distinct, median; metaconids opposite protoconids, no metastylids, m_3 unreduced. Two incisors, i_1 of moderate size, i_2 minute. Canine of moderate size. Jaw slender, front teeth semi-procumbent. Three small premolars, p_4 with triangular base and distinct deuteroconid.
   1. Paraconids strong, enamel smooth . . . . *Omomys*.
   2. Paraconids reduced, enamel wrinkled . . . . *Hemiacodon*.

III. Paraconids distinct, median, metaconids postero-internal to protoconids, no metastylids. Incisors small, canine of moderate size. Jaw short and deep anteriorly, front teeth vertical. Premolars crowded, p_{3-4} enlarged, trenchant with quadrate base, no deuteroconids........................*Uintanius.*

IV. Paraconids distinct, median, metaconids opposite protoconids, metastylids distinct. Two minute incisors, canine small, jaw short and deep anteriorly, front teeth vertical. Premolars crowded, small, deuteroconid distinct on p_{3-4}.
1. Molars broader, heel of m_3 bicuspid........................*Washakius.*
2. Molars narrower, heel of m_3 single........................*Shoshonius.*

V. Paraconids internal, more or less connate with metaconids; metaconids opposite or somewhat posterior to protoconids, no metastylids. Molar cusps less marginal than in the preceding groups. Jaw short and deep anteriorly. Premolars robust, no deuteroconids.
1. M_3 unreduced, paraconids vestigial except on m_1
   a. Two minute incisors, canine small. p_2 absent, p_4 smaller than m_1. *Anaptomorphus.*
   b. Anterior teeth unknown..............................*Euryacodon.*
2. M_3 reduced, paraconids more distinct, three premolars.
   a. Canine and one incisor moderately enlarged, posterior premolars much enlarged..*Absarokius.*
   b. No incisors, canine much enlarged, posterior premolars somewhat enlarged..*Tetonius.*

The geological range of the Eocene genera is as follows:

	Gray Bull	Lysite	Lost Cabin	L'r Bridger	Up'r Bridger
Omomys	*	*		*	?
Hemiacodon					*
Uintanius				*	*
Shoshonius			*		
Washakius				?	*
Anaptomorphus				*	
Euryacodon				*	
Absarokius		*	*		
Tetonius	*	*			

Omomys *Leidy* 1869.

Generic characters: Dentition $\frac{?\,?\,3.3.}{2.1.3.3.}$. Jaw long and slender, incisors semi-procumbent, the first somewhat enlarged, the second small. Canine larger than p_2, somewhat larger than i_1. Premolars with triangular bases, not crowded, p_2 very small, p_3 simple, high crowns, p_4 smaller than m_1, deuteroconid distinct. Molars with strong well separated paraconid, median or submedian in position; crowns low, cusps submarginal, enamel smooth. $M\frac{3}{3}$ unreduced. Upper molars trigonal, moderately wide, small conules, no mesostyle, very rudimentary hypocone. Upper premolars with large deuterocones on p^{3-4}, p^2 simple.

The typical species *O. carteri* is from the Bridger, and other species from the same horizon are referred to the genus by Wortman.

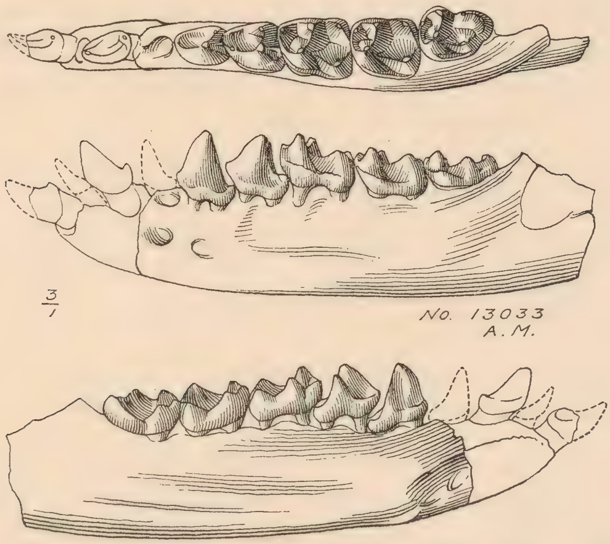


Fig. 20. *Omomys sp.*, lower jaw, inner, outer and crown views. Lower Bridger beds (Middle Eocene), Bridger basin, Wyoming. Front teeth restored from No. 12600.

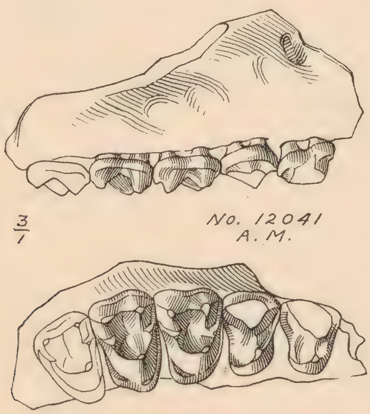


Fig. 21. *Omomys sp.*, upper jaw, outer and crown views. Upper Bridger beds (Middle Eocene), Bridger basin, Wyoming.

Omomys minutus (*Loomis*).

Notharctus minutus Loomis, 1906, Amer. Journ. Sci., Vol. XXI, p. 283, fig. 6.

Type, Amherst Mus. No. 365, a lower jaw with m_{1-3} perfectly preserved, and roots of p_{3-4}, from Lysite beds, Cottonwood Creek, Wind River basin, Wyoming.

Specific characters: $M_{1-3} = 5$ mm. Size of the Bridger species *Omomys ameghini* Wortman, but teeth narrower and paraconid more distinct, if Wortman's figure be accurate.

Through courtesy of Dr. Loomis I have been able to study this interesting little type which is unlike anything in the American Museum collections. The species agrees with *Omomys* in the construction of the molars, and in the slender jaw with premolar roots indicating that these teeth were of moderate width and not crowded. It is much smaller than *O. vespertinus* infra.

?**Omomys vespertinus** sp. nov.

Type, No. 16835, lower jaw with m_{1-3}, from Upper Gray Bull beds at head of Elk Creek in the Bighorn basin, Wyoming.

Paratype, No. 16213, upper jaw with p^3–m^3 from top of Almagre beds, San Juan basin, New Mexico.

Specific characters: $M_{1-3} = 7.8$ mm. Size of *O. carteri* but last molar smaller and paraconid on m_{2-3} more internal in position and partly connate with metaconid.

This species is very doubtfully referable to *Omomys*, the lower molars being intermediate in character between that genus and *Tetonius*. They have the low crowns and comparatively narrow proportions of *Omomys*,

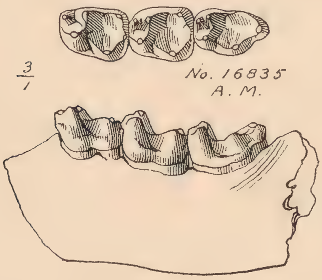


Fig. 22.

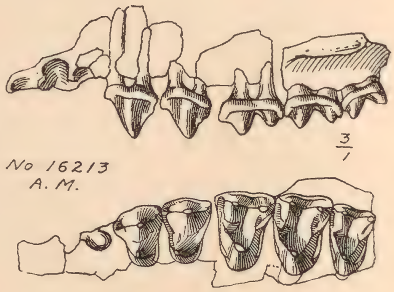


Fig. 23.

Fig. 22. *Omomys vespertinus*, lower jaw, outer view, and crown view of teeth. Type specimen, upper Gray Bull beds, Bighorn basin, Wyoming.

Fig. 23. *Omomys vespertinus*, upper jaw, outer and crown views. Paratype, top of lower (Almagre) beds of Wasatch, San Juan basin, New Mexico.

with small trigonid of less width than talonid; and the last molar is but little reduced. The position of the paraconid agrees better with *Tetonius*. The premolars and front teeth are unknown.

A well preserved jaw from the New Mexico Wasatch accords in size and proportions with the type, and is likewise of somewhat intermediate character although the relationship to *Omomys* is more evident. The last molar is slightly reduced but shows, like the others, the characteristic trigonal form, moderate width, minute conules, no mesostyle, and smooth enamel characteristic of *Omomys;* the premolars agree with that genus in their moderate width, triangular form and strong deuterocones. If this upper jaw be correctly referred, the species is properly referable to the genus. In *Tetonius* and *Absarokius* the molars are wider, more oval in form, m^3 more reduced, conules better developed; the premolars larger proportionately, wider transversely in *Tetonius,* the deuterocones more reduced in *Absarokius* and much more in *Uintanius.*

The alveoli of the front teeth in No. 16213 are partly shown. In front of p^3 are three small alveoli, the first two rather obscurely shown. These are probably an incisor, canine and p^2, but the front of the jaw is not well enough preserved to distinguish the maxillo-premaxillary suture, so that the interpretation is doubtful.

Hemiacodon *Marsh* 1872.

Hemiacodon Marsh, 1872, Amer. Journ. Sci., Vol. IV, p. 212; Wortman, 1904, *ibid.*, Vol. XVII, p. 135, figs. 128–132.

Type, H. gracilis Marsh from the Upper Bridger beds on Henry's Fork, Wyoming.

Generic characters: Dentition $\frac{?\ ?\ ?\ 3}{2.1.3.3}$. P^4 with strong deuterocone, upper molars wide transversely with strong conules, distinct protostyle and hypocone, no mesostyle, $m\frac{3}{3}$ unreduced, lower molars with median paraconid, reduced on m_2, vestigial on m_3, no metastylid, trigonids relatively small, entoconid of m_3 distinct; premolars not enlarged or crowded, p_{3-4} with triangular bases, deuteroconid distinct on p_4. Canine and first incisor moderately large, second incisor and p_2 very small. Jaw slender and rather shallow anteriorly, front teeth semi-procumbent. Enamel of molars and premolars heavily wrinkled.

This genus is confined to the upper part of the Bridger formation, where it is represented by two or more species, larger than any other Eocene Tarsiidæ. It is nearly related to *Omomys* and may be regarded as a derivative of that genus. Although fairly common, the skull is unknown and no skeleton material has been found associated with upper or lower jaws which were certainly of the same individual. Part of a skeleton associated with teeth of *Telmatolestes* and *Hyopsodus* is referred to *Hemiacodon* provisionally; it certainly does not belong to either of the two genera whose teeth were found with it; and among the known genera of appropriate size *Hemiacodon* and *Microsyops* are the only ones which are not excluded, either by direct or reasonably conclusive indirect evidence that their skeleton construction was widely different. If *Microsyops* is related to *Mixodectes* it is also excluded, but this is very doubtful. The reason for referring this partial skeleton and a number of isolated bones, of the same characteristic structure and similar size and proportions, to *Hemiacodon* rather than to *Microsyops* is that as with *Hemiacodon* they are strictly limited to the Upper Bridger. Smaller bones of similar type occur rarely in the Lower Bridger and are appropriate in size to the nearly related genus *Omomys.* None have been found in the Wind River or Wasatch formations. *Microsyops* on the other hand is more abundant in the Lower than in the Upper Bridger and the species only slightly smaller, while the closely related *Cynodontomys* is

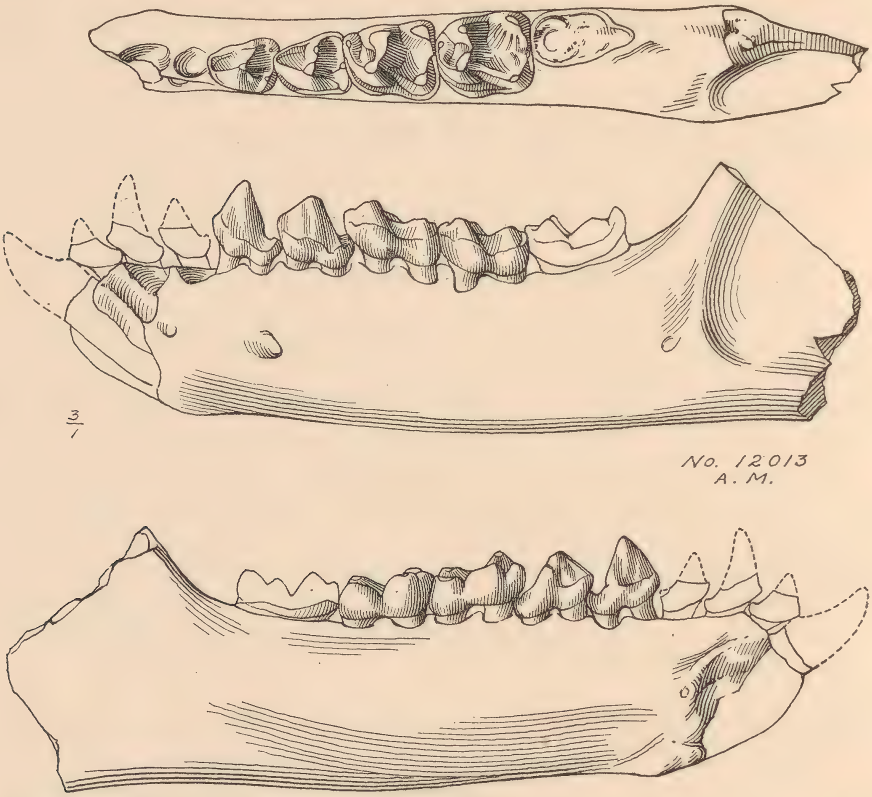


Fig. 24. *Hemiacodon gracilis*, lower jaw, inner, outer and crown views. Upper Bridger beds (Middle Eocene), Bridger basin, Wyoming. Front teeth restored from No. 12037.

fairly common in the Wind River basin and occurs also in the Bighorn basin, but no skeleton material of the type here under discussion has been found in these basins. This is by no means conclusive but in default of better evidence it may serve as a reason for referring this type of skeleton to *Hemiacodon* rather than to *Microsyops.* Wortman has referred an unassociated calcaneum of this type to *Microsyops,* stating that "there is no other known primate in the Bridger to which as regards size it could pertain." [1] But the size is more appropriate to *Hemiacodon.*

[1] Wortman, 1903, Amer. Journ. Sci., Vol. XVI, p. 209, fig. 115.

If this skeleton belongs to *Hemiacodon,* it confirms the affinity to *Tarsius;* although much less specialized than that genus it has the same elongated tarsals, large opposable hallux and other characters. If on the other hand it belongs to *Microsyops* it would place the lemuroid affinities of that genus beyond question and show that it was not related to the Mixodectidæ.

The description of this skeleton does not fall within the province of the present revision, but it appeared advisable to place on record the evidence for its reference to this genus as having an important bearing on the affinities of the Lower Eocene primate genera.

Washakius *Leidy* 1873.

Washakius LEIDY, 1873, Contrib. Ext. Faun. West. Terrs. (Rep. U. S. Geol. Geog. Sur. Terrs., Vol. I) p. 123, pl. xxvii, fig. 3; Wortman, 1904, Amer. Journ. Sci., Vol. XVII, p. 208, figs. 142–146.

Type, Washakius insignis Leidy from Bridger formation, Middle Eocene, of Wyoming.

Generic characters: Dentition $\frac{2.1.3.3}{2.1.3.3}$. Upper incisors and canine small, premolars of moderate size, p^{3-4} with strong deuterocones. Upper molars of moderate transverse width with small conules, rudimentary hypocones, no mesostyles. $M\frac{3}{3}$

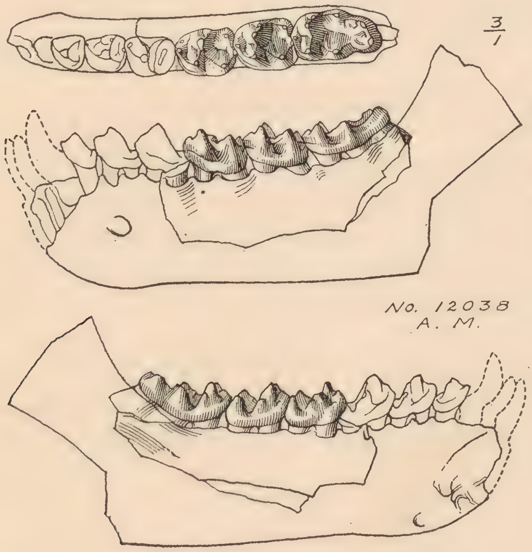


Fig. 25. *Washakius insignis,* lower jaw fragment, inner, outer and crown views. Front of jaw restored from No. 12040. Upper Bridger beds (Middle Eocene), Bridger basin, Wyoming

slightly reduced. Lower molars with distinct median paraconid and distinct metastylid; m_3 with distinct entoconid and double hypoconulid. Lower premolars of moderate size, p_2 being less reduced than in the other genera, crowded, with quadrate bases, low crowns, distinct deuteroconids on p_{3-4}. Lower canine of moderate size, two very small incisors. Jaw short and deep anteriorly, front teeth vertical. Enamel heavily wrinkled.

This genus is confined to the Bridger and chiefly found in the Upper Bridger although one specimen comes from near the top of the lower beds (Horizon B4). It is readily recognized by the peculiar construction of the molars, and the premolars are almost equally characteristic; they are short, wide, low-crowned, deuteroconid strong on p_{3-4}, p_4 with quadrate base. The second premolar is less reduced than in the other genera, the canine is moderately large, and in front of it two very small incisors. Two specimens in the American Museum have the premolars and first molar complete and alveoli of the three front teeth; Wortman had concluded from less perfect material that there was probably only one incisor. I have not seen the upper teeth of *Washakius;* Wortman's reference to it of a well preserved upper jaw in the Yale Museum appears to be well supported by the evidence and indicates that the hypocone is stronger in this genus than in any of the others from the American Eocene. The upper premolars have strong deuterocones, the molars are subtrigonal with small hypocone, no protostyle, minute conules, no mesostyle. The enamel of upper and lower teeth is heavily wrinkled, as in *Hemiacodon.*

Shoshonius *Granger* 1910.

Type, S. cooperi from Lost Cabin beds of Wind River basin, Wyoming.

Generic characters: Upper molars tritubercular with small conules and a mesostyle. Lower molars with strong well separated paraconid and a distinct cusp postero-internal to the metaconid. $M\frac{3}{3}$ unreduced. Enamel with heavy vertical wrinkling. Upper premolars with strong internal cusps. Width of teeth moderate.

This genus is closely allied to *Washakius*, from which it differs chiefly in the presence of a distinct mesostyle, the somewhat narrower molars and relatively larger trigonids, and absence of the cusp internal to the hypoconulid.

Shoshonius cooperi *Granger* 1910.

Shoshonius cooperi Granger, 1910, Bull. Amer. Mus. Nat. Hist., Vol. XXVIII, p. 249, fig. 5.

Type, No. 14664, upper jaw with p^3–m^3, from Lost Cabin beds of Wind River basin, Wyoming.

Specific characters: $M^{1-3} = 6$ mm.; $m_{1-3} = 7$ mm.

I refer to this species jaw fragments of six individuals, Nos. 14665–14670, from the same horizon and locality as the type. In No. 14670 the last upper

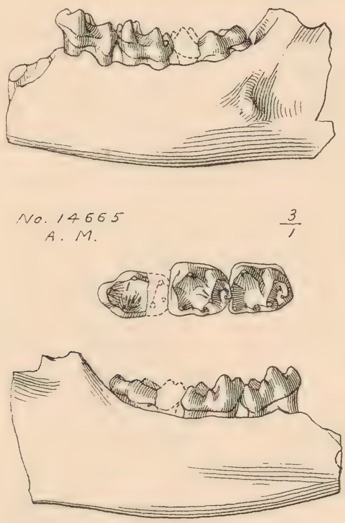


Fig. 26. *Shoshonius cooperi*, lower jaw, outer and inner views, and crown view of teeth, Lost Cabin beds, Wind River basin, Wyoming.

and last lower molar are associated. The others show only the lower molars. The lower premolars are unknown.

Uintanius gen. nov.

Type, U. turriculorum infra from the Middle Eocene Bridger formation of Wyoming.

Generic characters: Dentition $\frac{?\ ?\ 3.3}{?\ 1.3.3}$. Jaw short, deep anteriorly. Premolars enlarged, crowded, with compressed trenchant crests; deuterocones on upper premolars vestigial, no deuteroconids on lower premolars. Upper molars tritubercular with small conules, no distinct hypocones, no mesostyles. Lower molars with distinct median paraconid, metaconid set more posteriorly than protoconid, especially upon m_1, $m\frac{2}{3}$ little reduced; entoconid of m_3 distinct. Enamel smooth or faintly wrinkled.

This genus appears to be limited to the Bridger formation, and I have not recognized any Lower Eocene ancestors. It parallels *Absarokius* in the enlargement of the premolars, but the form of these teeth is quite different, and the molars are of very distinct pattern. The alveoli indicate a lower canine of moderate size and a small incisor in front of it, the other incisor if present was also small.

Uintanius turriculorum sp. nov.

Anaptomorphid gen. indesc., Matthew, 1909, Mem. Amer. Mus. Nat. Hist., Vol. IX, p. 549, pl. lii, fig. 7.

Type, No. 12598, lower jaw with p_3–m_3 figured, as above, from Grizzly Buttes, Lower Bridger beds, Horizon B_2.

Paratypes, No. 13039, upper jaw with p^3–m_2 from the base of the Upper Bridger, Horizon C, at Summers' Dry Creek; No. 12376, lower jaw m_{1-3} from the top of the Upper Bridger, Horizon D_4 on Henry's Fork Hill. All from the Bridger basin, Wyoming.

Specific characters: P_3–m_3 = 9 mm.; m_{1-3} = 6 mm.

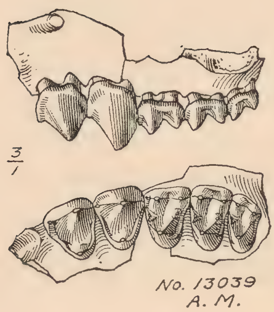


Fig. 28.

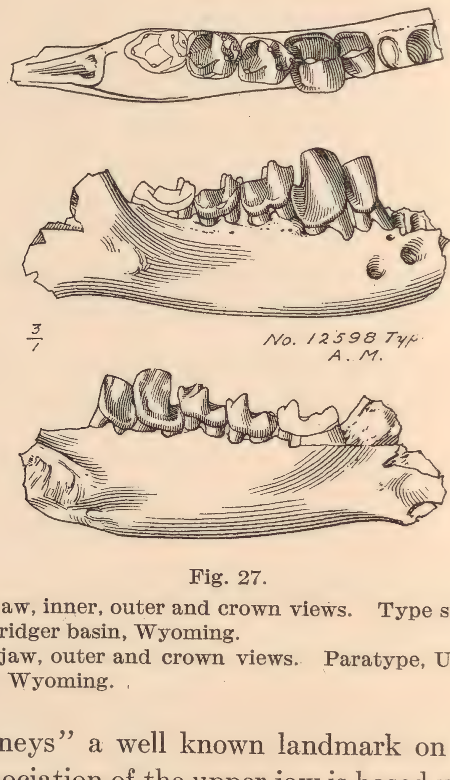


Fig. 27.

Fig. 27. *Uintanius turriculorum*, lower jaw, inner, outer and crown views. Type specimen, Lower Bridger beds (Middle Eocene), Bridger basin, Wyoming.

Fig. 28. *Uintanius turriculorum*, upper jaw, outer and crown views. Paratype, Upper Bridger beds (Middle Eocene), Bridger basin, Wyoming.

The name refers to "The Chimneys" a well known landmark on the north side of Henry's Fork. The association of the upper jaw is based upon correspondence in size and proportions, and especially upon the correspondence in type of the premolars, which are very different from any other genera of Tarsiidæ.

Anaptomorphus *Cope* 1872.

Anaptomorphus Cope, 1872, Palæont. Bull. No. 8, Oct. 8, 1872, Proc. Amer. Phil. Soc., Vol. XII, p. 554; *Anaptomorphus*, in part, Cope, 1885, Tert. Vert., p. 245, pl. xxv, fig. 10; Osborn, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 200 figs. 24, 25; Wortman, 1904, Amer. Journ. Sci., Vol. XVII, p. 211.

Type, A. æmulus Cope, from Lower Bridger of Wyoming.

Generic characters: Dentition $\overline{2.1.2.3}$. Upper teeth unknown; lower molars wide and short with internal paraconid vestigial on m_2, m_3 unreduced but crown unknown, p_4 robust, smaller than m_1, deuteroconid obscure, anterior teeth small, one-rooted, canine slightly larger than adjoining teeth, lower jaw short and moderately deep anteriorly, enamel not wrinkled. Outer cusps of molars less marginal than in preceding genera, more so than in *Tetonius* and *Absarokius*.

I refer to this genus only the type species represented by a lower jaw with p_4–m_2 and roots or alveoli of the remaining teeth. It appears probable,

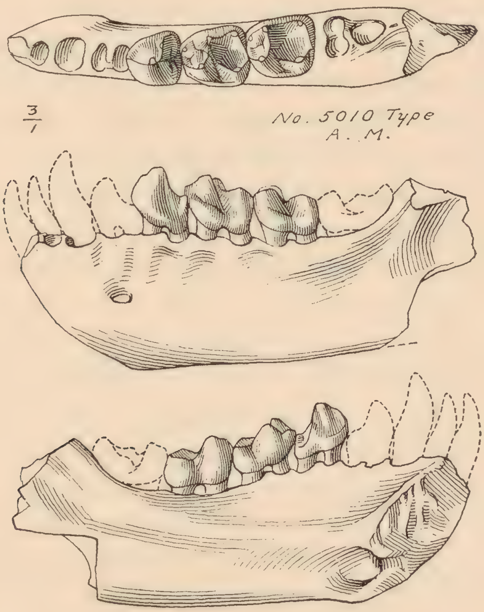


Fig. 29. *Anaptomorphus æmulus*, lower jaw, inner, outer and crown views. Type specimen, Lower Bridger beds (Middle Eocene), Bridger basin, Wyoming.

however, that this genus is a synonym of *Euryacodon* if Wortman is correct in referring certain lower jaw fragments to that genus. Doctor Wortman states that the paraconid is absent on all the molars in *Anaptomorphus* and holds the two genera separate on that ground; but it is certainly distinct on m_1 in the type and vestigial, rather than absent, on m_2, the apparent absence being due to wear.

Anaptomorphus homunculus is removed from the genus and made the type of *Tetonius* infra.

Tetonius gen. nov.

Type, Anaptomorphus homunculus Cope 1882.

Generic characters: Dentition $\frac{?.1.2.3}{0.1.2.3}$. Number and character of premaxillary teeth unknown. Anterior lower tooth (canine) much enlarged, rooted, subvertical.

Upper canine small, pointed conical with small posterior heel. Upper premolars very wide transversely with large deuterocones. Lower premolars crowded, p_2 quite small, p_3 larger, p_4 enlarged, robust with short heel and obscure deuteroconid. Molars very wide, $m_{\overline{3}}$ reduced, m^{1-2} with rudimentary hypocones, small conules, no mesostyles. Lower molars with paraconid internal, distinct on m_1, partly connate with metaconid on m_{2-3}. Protoconid and metaconid opposite. Cusps of cheek teeth low, massive, the inner cusps of upper series and outer cusps of lower series set well in from margin. Lower jaw short, very deep anteriorly, shallowing under molars. Skull shorter than in *Tarsius*, orbits smaller and less prominent, braincase smaller.

It is with much regret that I find it necessary to remove from the genus *Anaptomorphus* the well known species *A. homunculus.* Wortman in 1904 expressed the opinion that it was probably generically distinct, but refrained from proposing a new genus "until the dentition of both the Bighorn and the Bridger forms is more fully known." So far as the Bridger species *A. æmulus,* type of the genus, is concerned, no more is known of it than the typical jaw found by Cope in 1872, unless indeed certain jaw fragments referred by Wortman to *Euryacodon* belong to this genus.

Of "*Anaptomorphus*" *homunculus* we have a number of additional specimens, and these together with a careful restudy of those hitherto described, show that this species is widely different from the true *Anaptomorphus* in its anterior dentition. It has, as pointed out by Osborn, three lower premolars, instead of two, but in place of three anterior teeth (interpreted as two incisors and a canine) it has a single tooth much enlarged and set semi-vertically in the very deep symphyseal region of the jaw. This is clearly shown in three of our specimens; the others afford no evidence. In No. 41, in which the symphyseal region is obscured by a crust of hematite and has been differently interpreted by Osborn and Wortman, the two small alveoli in front of that for p^2 figured by Osborn are artefacts in the hematite crust; and a cautious removal of a part of this crust clears up the obscurity of the anterior teeth and shows that as in the other specimens described below (Nos. 15064 and 15072) there is a single large alveolus in front.

The skull, No. 4194, which is the type of the species, has been studied and described by several authors. As it is the only skull of this family known, and the oldest primate skull, it has naturally been widely noticed and discussed with regard to its morphologic characters and systematic relationships. In view of its importance it appeared advisable to supplement the photographs which will appear in Doctor Gregory's morphologic description by an attempt at reconstruction of the skull and jaws, the crushing being corrected and the missing parts restored, partly from other individuals (outline) and partly by analogy with *Tarsius* (dotted lines).

The method adopted for correcting the distortion due to crushing has been to draw separately each of the principal displaced portions of the skull in their true perspective with relation to the median plane and combine them so as to correct the overlap and displacement. This has been very conscientiously and skilfully executed by the artist, Mrs. L. M. Sterling, under my supervision, aided by criticism from Doctor Gregory and Mr. Granger, the *Tarsius* skull being used for guidance and comparison. I take pleasure in calling attention to the accuracy and excellence of Mrs. Sterling's work as instanced not only in the present difficult reconstruction but in the entire series of illustrations of Lower Eocene mammals treated in this revision, most of the specimens being fragmentary, many of them of minute size and some in poor preservation.

The skull of *Tetonius* will be described by Doctor Gregory; in the present revision I confine myself to a discussion of the tooth characters. These have already been considered by Cope, Osborn and Wortman, but the present interpretation differs from theirs in certain important particulars, especially as to the front teeth, which are so widely different from those of *Anaptomorphus* that the genus must be regarded as distinct.

Tetonius homunculus (*Cope* 1882).

Anaptomorphus homunculus Cope, 1882, Pal. Bull. No. 34 (Feb'y. 22), Proc. Amer. Phil. Soc., Vol. XX, p. 152; 1885, Tert. Vert., p. 249, pl. xxive, fig. 1; Osborn, 1892, Bull. Amer. Mus. Nat. Hist., Vol. IV, p. 103, fig. 6; 1902, *ibid.*, Vol. XVI, p. 200, figs. 24, 25; Hubrecht, A. A. W. 1897, Descent of the Primates (Princeton Lecture), p. 18, figure; Wortman, 1904, Amer. Journ. Sci., Vol. XVII, p. 248.

Type, No. 4194, Cope Coll., a skull from the Wasatch of the Bighorn basin, Wyoming.

Specific characters: Lower molars m_{1-3} = mm. Teeth wider and more massive, jaw deeper than in the following species.

Besides the type skull, No. 41 upper and lower jaws, No. 15063 upper and lower jaws, No. 15062 upper jaw, and Nos. 42, 43, 15064, 15065 and 15693 lower jaws, are referred to this species.

Observations upon the type skull. The premaxillary region is broken off, the fractured surface apparently coinciding at several points with the maxillo-premaxillary suture. The fracture has, however, lost some of its freshness owing to repeated handling of the specimen during the thirty-five years since its discovery, and the sutural surfaces cannot be recognized with absolute certainty. The maxillary teeth were interpreted by Cope and Osborn as canine, two premolars and three molars. Wortman states that there is evidence of seven teeth, the most anterior represented by an alveolus. But it does not appear to me that the small concavity on the fractured anterior face of the right upper jaw which he interprets as a portion of a tooth socket warrants any such positive statement. It may be a portion of an alveolus, but it is not certainly so. At all events no portion of an alveolar border is preserved. Nor is Wortman's statement that in the maxilla, No. 41, there is evidence of a tooth with more than a single root in advance of the two premolars confirmed by careful study of the specimen. If it were so this specimen would disagree with the typical skull, in which the tooth in advance of the premolars is single-rooted, and separated from them by a short diastema; but this second maxilla agrees in both particulars with the type so far as I am able to judge.

That this single-rooted tooth is a premolar as Wortman believes, appears to me improbable on account of the diastema between it and p^3. A diastema

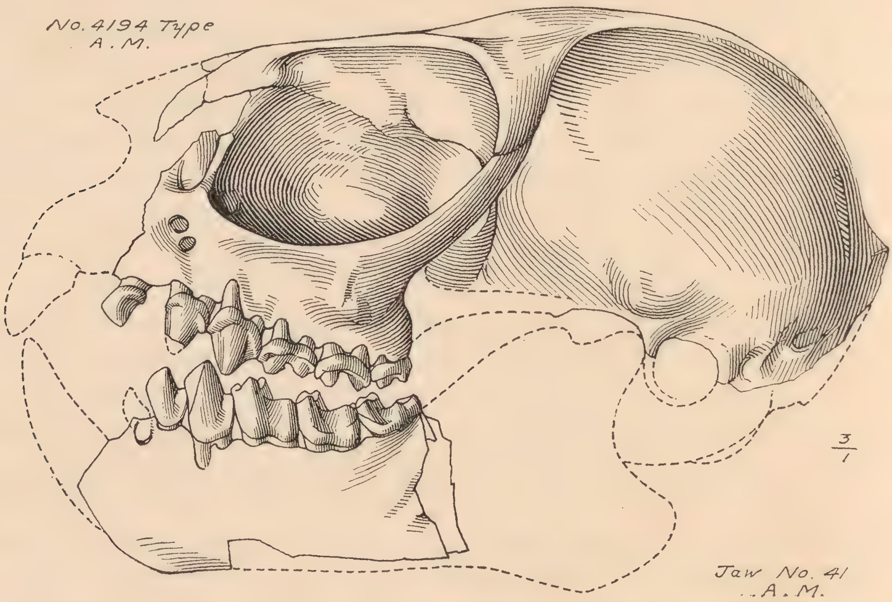


Fig. 30. *Tetonius homunculus* (Cope), skull and lower jaw, left side view, distortion of skull corrected. Type skull of *Anaptomorphus homunculus*, Gray Bull beds, Bighorn basin, Wyoming. Lower jaw from No. 41, same horizon and locality.

between p^2 and p^3 in so short and crowded a dentition would be very unlikely; on the other hand if p^2 is suppressed the postcanine diastema is quite natural. The form of the tooth in question is not decisive, but is more suggestive of a canine, and if the remnants of the maxillo-premaxillary suture are correctly identified on the broken anterior face of the skull, the position of the tooth in question is so close behind it that it must have been a canine unless this tooth was suppressed, which is less probable than the suppression of p^2.

I conclude that Cope's and Osborn's interpretation of this tooth as the canine is correct.

There is no evidence as to the premaxillary teeth in any of our specimens. By analogy with *Tarsius* I suppose it probable that there was one enlarged incisor, and that probably the others were suppressed, as the lower front teeth are more specialized than in the modern genus. The premolars are very wide transversely with large deuterocones, especially on p^4, rudimentary stylar cusps and strong anterior and posterior cingula. The molars are also very wide transversely, with rudimentary hypocones, small conules, no mesostyle; the parastyle rudimentary. The third molar is much reduced and has only the three principal cusps.

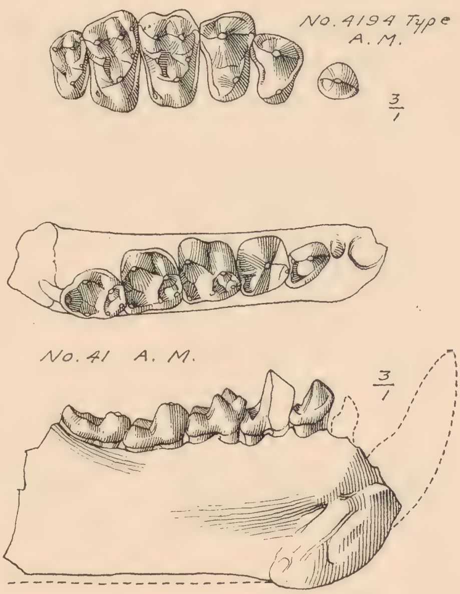


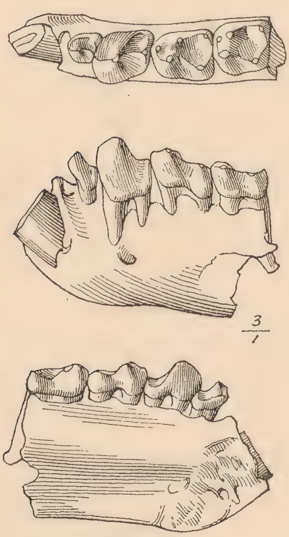
Fig. 31. *Tetonius homunculus* (Cope), lower jaw, inner and crown views, from No. 41; and crown view of upper teeth, from type specimen, Gray Bull beds, Bighorn basin, Wyoming.

Observations upon referred specimens. In the second specimen, No. 41, p^3–m^3 are preserved, with part of the canine alveolus. It agrees quite nearly with the type, save that the hypocones appear slightly less prominent. Two other upper jaws are likewise in close agreement. In No. 41 and No. 15063 upper and lower teeth of the same individual are associated. Nos. 42, 15064–5 and 15693 are lower jaws with from two to five cheek teeth preserved. All agree quite closely in the corresponding parts. In No. 15064 the alveoli of the large anterior tooth (canine?) and a small one behind it are shown, followed by p_3–m_3 well preserved. In No. 41 p_3–m_3 are preserved, in front of them is a small alveolus and in front of that a large alveolus close to the symphysis. The proportions and relations of this enlarged front tooth, which I regard as probably a canine, appear to be the same as in the smaller species *T. ambiguus* in which its root is preserved. The lower jaw is deeper and heavier in the symphyseal region than in *Anaptomorphus* or other genera with small front teeth, but not as deep as in *Trogolemur*.

P_2 is a very small one-rooted tooth, but is not preserved in any of our specimens. P_3 and p_4 are robust crowded teeth ridged antero-internally and postero-externally, with rudimentary deuteroconid on p_4, short wide heels on both. P_3 has two connate roots much compressed antero-posteriorly; in p_4 they are more distinct and less compressed. The premolars are throughout of similar type to those of *Absarokius,* only much less exaggerated.

The molars are characterized not only by their great width, the first and second being as wide as long or wider, but by the approximation of the outer cusps towards the centre of the tooth, and the unusual height, not of the cusps which are low, but of the crown of the tooth as a whole, especially when viewed from the external side. The paraconid is distinct on m_1 but decidedly lower than the other trigonid cusps; on m_2 and m_3 it is rather closely connate with the metaconid, but always recognizable. M_3 is about as long as m_2 but barely two thirds as wide; its hypoconulid is moderately wide and entoconid semi-distinct.

Comparison with Trogolemur. Tetonius has the same dental formula and the front tooth enlarged; nevertheless the detailed comparison of the lower teeth does not indicate close affinity. In *Trogolemur* the root of the front tooth reaches far under the molars, the premolars are not enlarged or crowded, the last molar is unreduced, and the paraconid, although internal, is not connate with the metaconid. The molars are moderately wide, but the outer cusps are marginal, and the outer cingula are very prominent. It has much resemblance to the Tarsiidæ generally but no special resemblance to *Tetonius.*



No. 15072 A. M.

Fig. 32. *Tetonius ambiguus,* lower jaw, inner, outer and crown views. Type specimen, Gray Bull beds, Bighorn basin, Wyoming.

Tetonius ambiguus sp. nov.

Type, No. 15072, lower jaw with p_3–m_2 and roots of front teeth, from the lower Gray Bull beds in the Bighorn basin, Wyoming.

Specific characters: Molars of less width than in *T. homunculus,* third premolar relatively small, canine proportionately large, jaw of less depth anteriorly.

The type of this species gives some indications of the character of the enlarged front tooth. The root is compressed oval, flattened on the inner side smooth and uniform, indicating probably a crown somewhat like that of *Cynodontomys,* but set rather more vertically.

Measurements: P_3–m_2 = 7.5 mm., approximately the same as in *T. homunculus.*

Tetonius musculus sp. nov.

Type, No. 12830, lower jaw with m_3 and roots or alveoli of the preceding teeth, from the Lysite horizon in the Wind River basin, Wyoming.

Specific characters: Lower jaw much more slender than in *T. homunculus* or *ambiguus*, canine root less compressed, premolars and molars less robust, m_3 less reduced, heel longer.

This species has a much less specialized dentition than the two preceding but comes from a later horizon. Its reference to the genus is open to question. It is about the size of *Omomys minutus* (Loomis) and is from the same

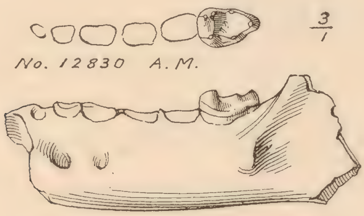


Fig. 33.

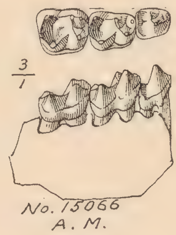


Fig. 34.

Fig. 33. *Tetonius musculus*, lower jaw, outer view, and crown view of last molar. Type specimen, Lysite beds, Wind River basin, Wyoming.

Fig. 34. *?Tetonius musculus*, lower jaw fragment, with p_4–m_2, outer and crown views. Gray Bull beds, Bighorn basin, Wyoming.

locality and horizon, but is readily distinguished by the deeper jaw, shorter premolars, m_3 with paraconid internal and connate with metaconid.

No. 15066, lower jaw fragment with p_4–m_2 compares with this species, but if identical it can hardly be regarded as congeneric with *T. homunculus.*

Absarokius gen. nov.

Type, *Anaptomorphus abbotti* Loomis, 1906.

Generic characters: Dentition $\overline{1.1.3.3.}$ Molars similar to *Tetonius;* premolars of similar type but more specialized. Two lower front teeth in advance of p_2, subequal and of moderate size, presumably incisor and canine. Fourth upper premolars oval, triangular, moderately wide, with small deuterocone; lower premolars crowded, much enlarged, with quadrate bases, deuteroconids absent, more turgid than in *Uintanius* and without anterior cusp or blade. Upper molars ovate-trigonal, wide transversely, protocones set far in from margin, m^3 much smaller than m^2, wide transversely, suboval. Lower molars wide with low cusps, the outer cusps set far in from margin, paraconid distinct on m_1, internal and connate with metacone on m_{2-3}. Last lower molar considerably reduced, hypoconulid small, narrow, entoconid indistinct.

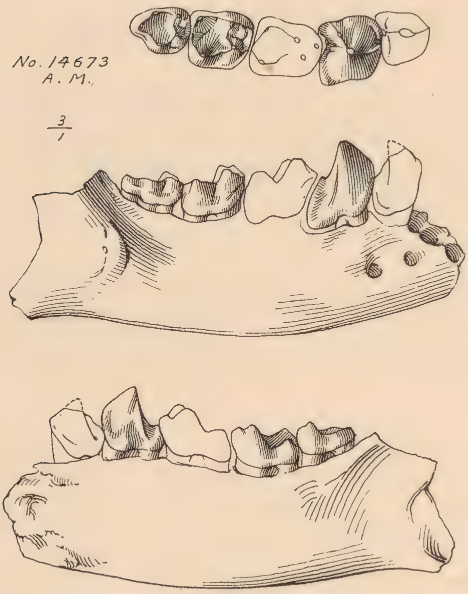


Fig. 35. *Absarokius abbotti*, lower jaw, inner and outer views, and crown views of teeth. Lysite beds, Wind River basin, Wyoming.

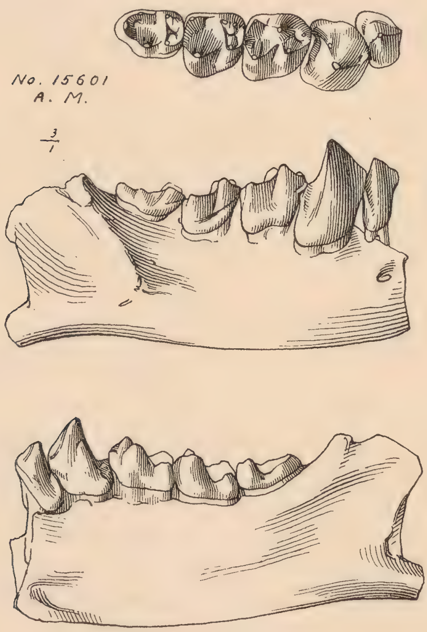


Fig. 36.

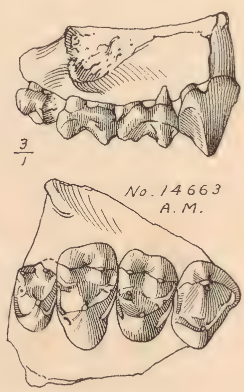


Fig. 37.

Fig. 36. *Absarokius noctivagus*, lower jaw, inner and outer views, and crown view of teeth. Type specimen, Lost Cabin beds, Bighorn basin, Wyoming.

Fig. 37. *Absarokius noctivagus*, upper jaw, outer and crown views. Paratype, Lost Cabin beds, Wind River basin, Wyoming.

Two species are placed under this genus, *Anaptomorphus abbotti* Loomis of the Lysite and a new species, *noctivagus*, of the Lost Cabin beds. So far as the premolar and molar teeth are concerned they would appear to be progressively specialized descendants of *Tetonius homunculus* of the older Gray Bull horizon. But the front teeth are differently specialized, *Tetonius* having a single tooth much enlarged in front of the small p_2, while in *A. abbotti* there were clearly two of moderate size. *A. noctivagus* appears to be nearly allied to *A. abbotti* in dentition, but somewhat more progressive; the lower front teeth are not shown in any of our specimens, but the characterization of the upper premolars and molars is based upon this species.

Despite the difference in the front teeth it appears probable that this genus is very closely allied to *Tetonius*. Were it not for the single specimen of *A. abbotti* in which the alveoli of the front teeth are preserved, I should regard the three species *homunculus*, *abbotti* and *noctivagus* as three stages of a genetic series. It is possible that this is really the case, and the *abbotti* lower jaw is abnormal. But in default of evidence I do not venture to assume so.

Order INSECTIVORA.

Under this order are placed ten genera of Lower Eocene mammals,[1] most of them, however, *incertæ sedis*. It is not possible clearly to delimit the order from the Primates on one hand and the Carnivora (Creodonta) on the other, except through characters of skull and skeleton, and in some groups these parts are unknown. But even when the skeleton is known the order is not very clearly defined. It includes a number of families placed here for lack of a more suitable location rather than from any special affinities to the typical Insectivora. The modern order is so largely defined by negative characters, by lack of the characteristic specializations of the other orders, that it has served as a sort of palæontological scrap-basket, a container of odds and ends.

So far as the teeth are concerned, the order is in general characterized by small size and lack of specialization of the canine as a prehensile tooth, one or more of the incisors frequently being enlarged to take its place. The cheek teeth are typically insectivorous, with sharp triangular cusps, affording numerous small shearing edges. But the Pantolestidæ have a Creodont type of teeth, although in skull and skeleton they are unmistakably Insectivora, and the Apatemyidæ and Mixodectidæ have Lemuroid

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[1] *Diacodon, Parictops, Palæosinopa, ?Nyctitherium, ?Apheliscus, ?Didelphodus, ?Creotarsus, ?Cynodontomys, ?Phenacolemur, ?Nothodectes.*

molars although other features indicate that they are more probably Insectivora.

In absence of satisfactory evidence I have made only such changes in the accepted arrangement as seem sufficiently well founded to be permanent.

The reference of the Apatemyidæ and Mixodectidæ to the Insectivora rather than to the Primates has been discussed by Matthew in 1909. No conclusive evidence as to the affinities of either of these groups has been furnished by the new material from the Lower Eocene. Such additional data as are at hand tend to emphasize the affinities of both to the Eocene Tarsiidæ, whose reference to the Primates rests upon very strong evidence.[1] The affinities of all these Eocene Primate and near-Primate groups will be re-examined and the evidence evaluated by my colleague Dr. Gregory, to whose able and judicial consideration I leave the question, observing that the retention of the two families in the more generalized and primitive group Insectivora seems advisable until adequate evidence is at hand of their belonging to the more specialized and progressive group Primates.

MIXODECTIDÆ.

The reference of *Cynodontomys* and *Microsyops* to this family appears to be open to serious doubt. The lower molars are unquestionably much like those of *Mixodectes*, but there the resemblance ends. The upper molars are by no means so close; the premolars are of wholly different type, and the homologies of the enlarged front teeth may not be the same. In *Mixodectes* the three premolars are preceded by a canine, recognizable by its larger size than p_2 and more external position; and in front of this is the enlarged spatulate tooth which must therefore be an incisor. In *Microsyops* there are apparently three premolars decreasing progressively forward, and the tooth in front of them may be either an incisor or a canine. In the upper jaw of *Indrodon*, a near relative of *Mixodectes*, there are three premolars, progressively smaller forward, a moderately large one-rooted canine in front of them, and two incisors, the more median one enlarged. In the upper jaw of *Microsyops* there are three premolars progressively smaller forward, and front of them and just behind the maxillo-premaxillary suture is a two-rooted canine, a little larger than p^2 and more externally set; the premaxilla is unknown but must have had an enlarged incisor to correspond to the enlarged lower tooth. $P\frac{4}{4}$ of *Mixodectes* is a peculiarly specialized tooth, the principal cusp high, stout, simple and somewhat recurved. In

[1] Although it is far from certain that *all* of the Eocene genera referred to this family are Primates.

Cynodontomys and *Microsyops* $p\frac{4}{4}$ are progressively molariform, smaller than m_1 but do not appear to be derived from the peculiar *Mixodectes* type.

The type species of *Cynodontomys* and *Microsyops* are from the Lysite and Lower Bridger, and are in fact so much alike that the genera would be better united were it not for the more diverse species found in the Gray Bull below and Upper Bridger above. The successive species between these two extremes form a progressive series, but the amount of change in the teeth is not large as between any two successive stages, and in the molars it is hardly appreciable.

Metolbodotes. Schlosser[1] has referred to the Mixodectidæ under this name a lower jaw from the Fayum Oligocene of Egypt. The only grounds that I can discover for this reference are that it has the same dental formula as that ascribed to *Olbodotes* by Osborn (erroneously so, I believe, for a careful re-examination of the type of Osborn's genus by Mr. Granger and myself leads to the conclusion that it is identical with *Mixodectes*). The teeth of *Metolbodotes,* so far as one may judge from Schlosser's figures, are wholly unlike those of either *Mixodectes* or *Microsyops,* but they agree very well with those of Erinaceidæ, to which family the genus probably belongs. It certainly is not related to the Mixodectidæ and cannot therefore afford any confirmatory evidence as to their Insectivore affinities, as Schlosser affirms that it does.

Key to Genera of Mixodectidæ.

A. *Mixodectinæ:* Upper molars quadrangular with strong hypocone. P^4 with high robust backwardly curved external cusp and small internal cusp; p_4 with high stout protoconid and low heel. Three premolars. Canine reduced.
   Mixodectes (*Olbodotes*), *Indrodon.* Paleocene, Torrejon beds.

B. *Microsyopinæ:* Upper molars triangular with weak hypocone. $p\frac{4}{4}$ progressively molariform, the cusps corresponding in form and position to those of the molars. Three premolars, lower canine absent.[2]
   1. *Cynodontomys.* P^4 with trittocone smaller than protocone, parastyle distinct, posterior wing of deuterocone crescent rudimentary; p_4 with deuteroconid smaller than protoconid.
   2. *Microsyops.* P^4 with trittocone and protocone of equal height and size, no parastyle, posterior wing of deuterocone crescent fully developed; p_4 with deuteroconid and protoconid of equal height.

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[1] Schlosser, 1910, Zoöl. Anz., Bd. XXXV, s. 507; 1911, Beit. z. Pal. Oest.-Ung., Bd. XXIV, s. 70, taf. ix, fig. 5.

[2] Or lower canine much enlarged, incisors absent; see preceding discussion.

Microsyops *Leidy* 1872.

Type, M. gracilis Leidy, from Lower Bridger of Wyoming.

The Bridger species are all distinguished by equal height of the two outer cusps (protocone and deuterocone) of p^4, and of the two trigonid cusps, protoconid and deuteroconid, of p_4. These, with the broader and more distinctly bicuspid basined heel of p_4, and presence of a strong curved crest on the same tooth in the position of the paraconid of the true molars, are the only generic distinctions which I can make from *Cynodontomys*. But *M. scottianus* of the Wind River agrees with *Cynodontomys* in all except the broader heel of p_4, and even this is not so distinctly bicusped as in the Bridger species. It should be transferred to *Cynodontomys*. This leaves *Microsyops* as an exclusively Middle Eocene genus.

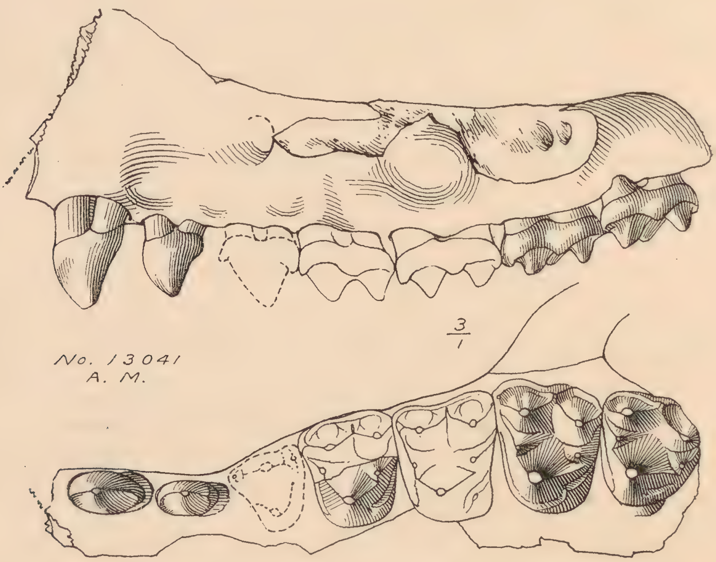

Fig. 38. *Microsyops elegans*, upper jaw, outer and crown views. Bridger beds (Middle Eocene), Bridger basin, Wyoming. M^1 and part of p^4 drawn from No. 12592.

Discussion of ordinal affinities. The molar teeth of *Microsyops* and *Cynodontomys* are not unlike those of the Eocene Tarsiidæ in construction. The lower molars have small triangular trigonids somewhat constricted off from the large basined talonids. The paraconid is distinct but low; in the Anaptomorphidæ, when distinct, it is more nearly on a level with the other cusps. The hypoconulid is distinct on m_{1-2} while in Tarsiidæ it is usually absent; on m_3 the entoconid is a distinct cusp, while in most Tarsiidæ it is a marginal crest on the basin. The premolars are of wholly diverse type and trend.

It is unfortunate that among nearly one hundred catalogued specimens of these two genera not one has any limb or foot material positively associated

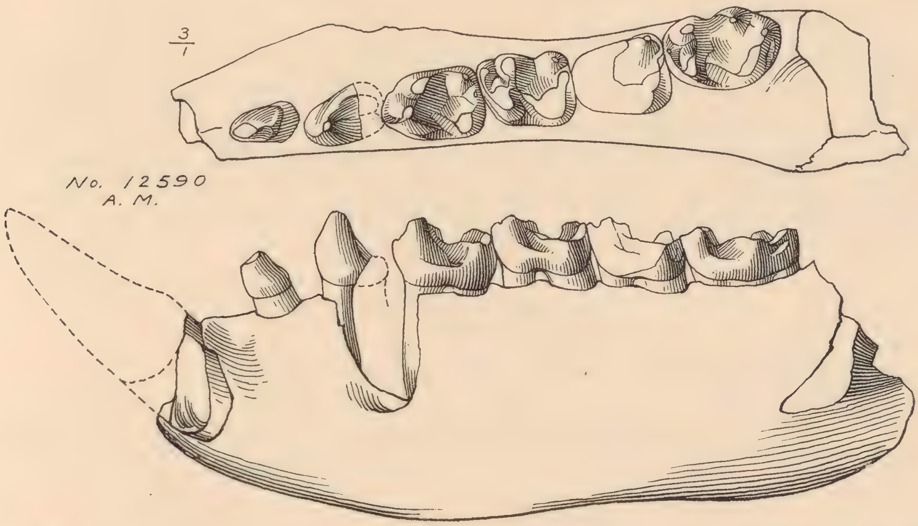

Fig. 39. *Microsyops elegans*, lower jaw, outer and crown views. Bridger beds (Middle Eocene), Bridger basin, Wyoming.

as belonging to the same individual. Nor is there any such association among the specimens of *Microsyops* in the Yale Museum. Wortman arbitrarily referred to this genus an isolated calcaneum of undoubted lemuroid type, and we have several isolated calcanea and other foot-bones apparently of the same form, as well as a considerable part of the hind limbs and feet in association. But for reasons stated on a preceding page I think the genus is more probably *Hemiacodon*.

Setting aside this evidence there is nothing really decisive. The molar teeth are undoubtedly like those of Tarsiidæ and other Primates; but they are equally like those of *Mixodectes* and *Chriacus*, which are not Primate. The molariform fourth premolar is characteristic of two or three groups of Insectivora and is rare among Primates (Galaginæ only). The double-rooted canine and

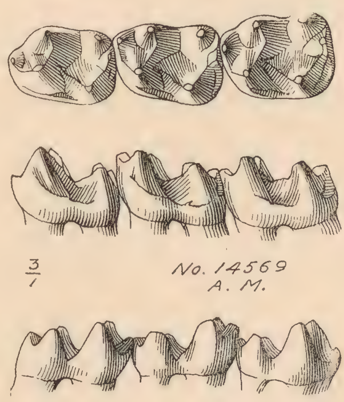

Fig. 40. *Microsyops elegans*, fourth premolar and first and second molars, unworn, inner outer and crown views. Bridger beds (Middle Eocene), Bridger basin, Wyoming

the enlarged lower front tooth are also more characteristic of Insectivora than of Primates. But among the Eocene Tarsiidæ certain genera show an approach to these peculiar specializations of *Microsyops* sufficient to suggest relationship, save for the double-rooted upper canine, and the absence of this peculiarity is not demonstrated except in *Tetonius* (and of course *Tarsius* itself).

I conclude that there is no satisfactory evidence either for or against Primate affinities and in default of such evidence have left the two genera *Cynodontomys* and *Microsyops* in the Mixodectidæ to which they were referred by Cope, Osborn and Wortman. As *Mixodectes* is certainly not a Primate and is very probably an insectivore, these Eocene genera must come provisionally under the order Insectivora.

Cynodontomys *Cope* 1882.

Type, C. latidens Cope, from the Lysite horizon, Wyoming.

The three species included under this genus show a progressive molarization of p$\frac{4}{4}$ and increase in size, but there are no clearly defined progressive

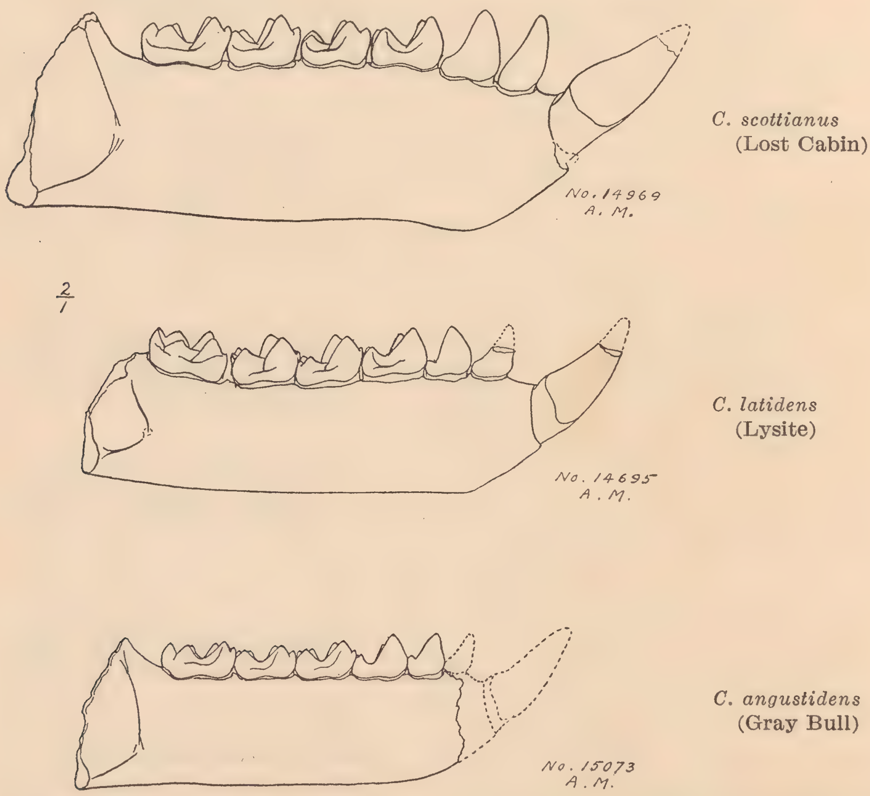

Fig. 41. Outlines of the lower jaws, outer view, of the three species of *Cynodontomys*. All twice natural size.

characters in the molar teeth. They appear to be in genetic sequence, the stage of progress of each specimen being in exact correspondence with its recorded geological level.

Key to Species of Cynodontomys.

1. *C. angustidens* sp. nov. P_4–m_3 = 14 mm. P_4 narrower, oval, with small heel and deuteroconid much smaller than protoconid.
2. *C. latidens* Cope. P_4–m_3 = 15 mm. P_4 with deuteroconid distinctly smaller than protoconid, heel narrower than in *C. scottianus*, its cusps less separate.
3. *C. scottianus* (Cope). P_4–m_3 = 17.3 mm. P_4 with deuteroconid a little smaller than protoconid, and heel broad basined with hypoconid and entoconid wide apart.

The geological occurrence is as follows:

	Bighorn Basin	Wind R. Basin	Beaver Divide	Clark Fork Basin
Lost Cabin	C. scottianus 1 sp'm	C. scottianus 17 sp'm's	C. scottianus 1 sp'm	
Lysite	C. latidens 16 sp'm's	C. latidens 2 sp'm's		
Gray Bull	C. angustidens 9 sp'm's			C. angustidens 1 sp'm

I have not identified the genus with certainty from the New Mexican Wasatch, nor from the Clark Fork beds. A single specimen from the lowest Gray Bull level in Clark Fork basin appears to be a primitive mutant of *C. angustidens.*

The Paleocene ancestors of *Cynodontomys* have not been found, or at all events have not been recognized as such.

Cynodontomys scottianus *Cope.*

Microsyops scottianus Cope, 1881, Bull. U. S. G. S. Terrs., Vol. VI, p. 188; 1885, Tert. Vert., p. 217, pl. xxiva, fig. 2; Osborn, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 209, fig. 36.

Type, No. 4748, left ramus of lower jaw with p_4 and alveoli or roots of remaining teeth. Wind River basin, Wyoming. Wortman, 1881. Probably Lost Cabin beds.

Distinctive characters: P_4–m_3 = 16.8–17.8 mm. P_4 less molariform than in *Microsyops*, more than in *C. latidens*. M_3 unreduced. P_3 two-rooted, obliquely set in type, usually straight.

This species agrees with *Cynodontomys* in the inequality of the two outer cusps of p^4, the lack of trittoconid and inequality of pr^d and de^d on p_4, which appear to be the best distinctive characters of *Cynodontomys.* It is therefore transferred to that genus.

Some twenty jaws or parts of jaws from the Lost Cabin horizon of the Wind River basin agree with the type in all essentials. No. 14969, a well preserved right and left ramus represents the species in the collection from Beaver Divide, south of Lander, Wyo., the teeth complete except for the tip of the incisor. One ramus is abnormal in the lack of p_3.

The enlarged front tooth has a pointed subspatulate crown, wedge-shaped in cross section with nearly flat inner surface, moderately convex

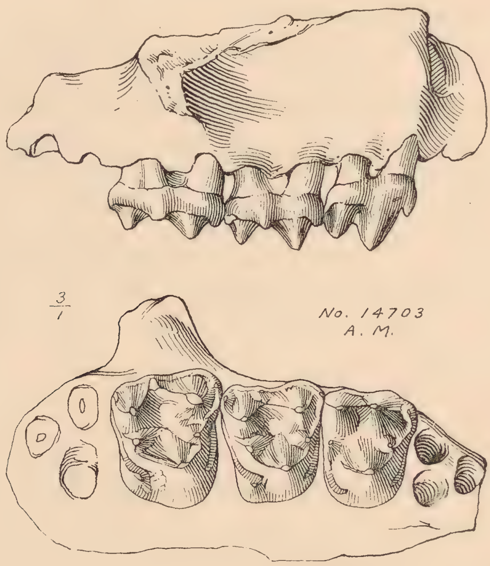

Fig. 42. *Cynodontomys scottianus*, upper jaw, outer and crown views. Lost Cabin beds, Wind River basin, Wyoming.

outer surface, sharp posterior and thick rounded anterior border. It is not so long as in *Mixodectes*, more flattened. The tooth behind it is determined by Osborn as a canine, but appears to be more probably a premolar (p_2). It has a simple pointed crown and two connate roots. The third premolar has two well separated roots and a simple pointed trenchant crown with small heel. P_4 is submolariform, with strong inner cusp nearly as high as the protoconid, broad bicuspid heel.

The fourth upper premolar has two strong external cusps, the posterior one a little lower than the anterior, distinct conules and parastyle, and the inner half of the tooth is broadened out so as to give it a subquadrate form like the molars. Mesostyle absent on p^4, rudimentary on m^{1-2}.

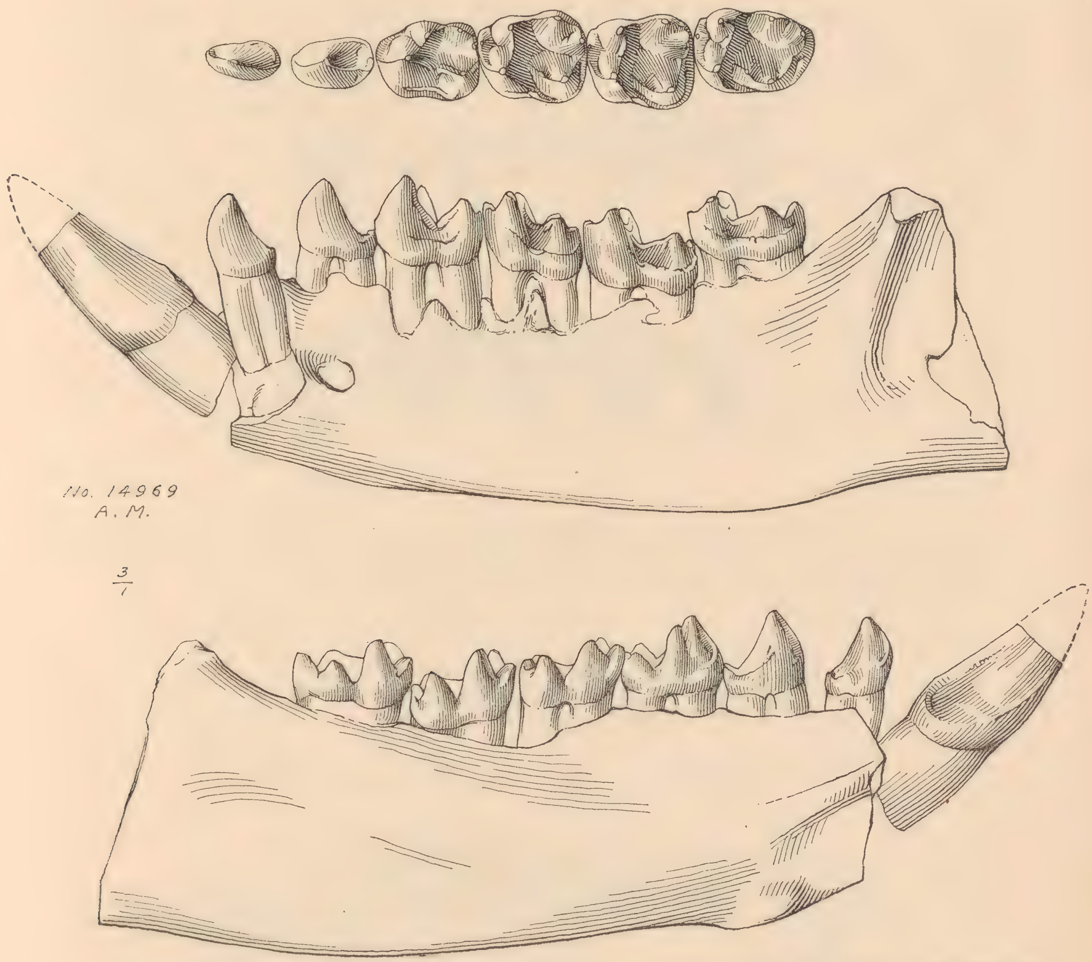

Fig. 43. *Cynodontomys scottianus,* lower jaw, inner and outer views, and crown view of teeth. Lost Cabin beds, Beaver Divide, Wyoming.

Cynodontomys latidens *Cope.*

Cynodontomys latidens Cope, 1882, Proc. Amer. Phil. Soc., Vol. XX, p. 151; 1885, Tert. Vert., p. 244, pl. xxive, fig. 2; Osborn, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 209, fig. 35.

Pelycodus angulatus Cope, 1885, l. c., p. 231; (*Chriacus*) *ibid.*, pl. xxive, fig. 4; (*Cynodontomys*) Osborn, 1902, l. c., p. 208. Probably not *P. angulatus* Cope, 1875, Syst. Cat. Eoc. Vert., p. 14; (*Tomitherium*), 1877, Ext. Vert. New Mex., p. 144, pl. xxxix, fig. 15.

Notharctus palmeri Loomis, 1906, Amer. Journ. Sci., Vol. XXI, p. 284, fig. 7.

Notharctus cingulatus Loomis, 1906, l. c., fig. 8.

Type, No. 4195, both rami of lower jaw with m_{1-2}r., p_4l. and alveoli of remaining teeth. Bighorn basin, Wyoming Wortman, 1881. Probably Lysite horizon.

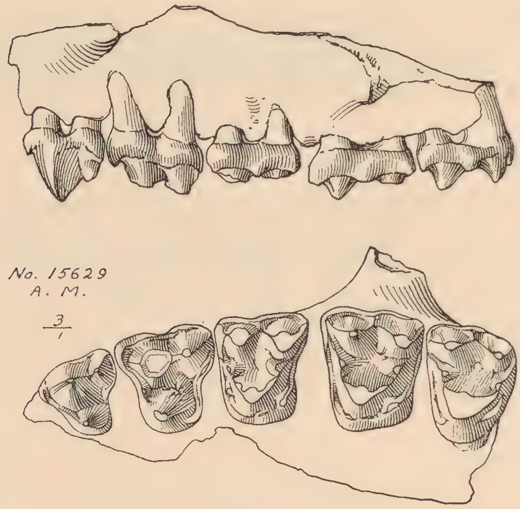

Fig. 44. *Cynodontomys latidens*, upper jaw, outer and crown views. Lysite beds, Bighorn basin, Wyoming.

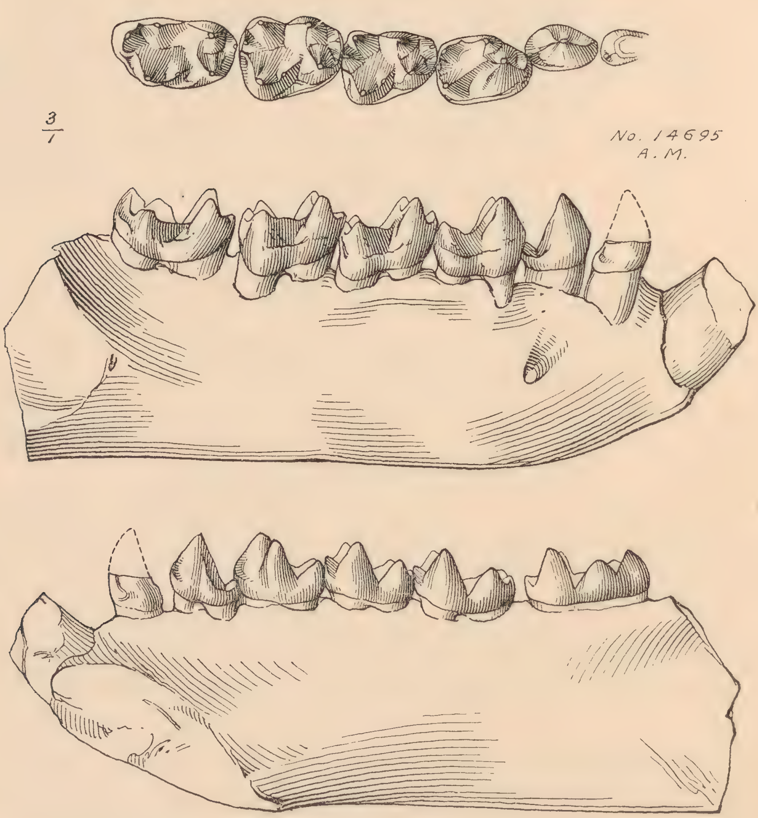

Fig. 45. *Cynodontomys latidens*, lower jaw, inner and outer views, and crown view of teeth. Lysite beds, Wind River basin, Wyoming.

Metatype of *Pelycodus angulatus*, No. 4184, lower jaw with p_4–m_2 and alveoli of p_3 and m_3, from Bighorn basin.

Distinctive characters: P_4–m_3 = 15 mm.; p_4 somewhat narrower than in *C. scottianus*, more oval, heel cusps less separate, m_3 relatively smaller.

Twelve or more jaws from the Lysite horizon in the Bighorn basin and two from the corresponding level in the Wind River basin are definitely referable to this species, others more fragmentary probably belong to it.

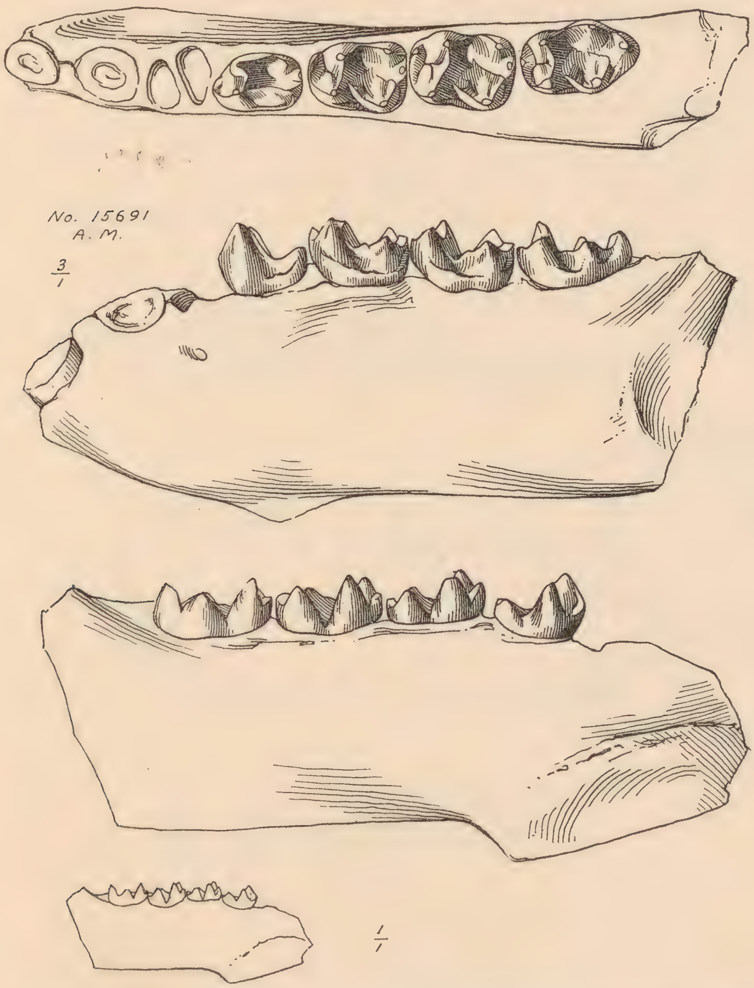

Fig. 46. *Cynodontomys ?latidens*, lower jaw, inner, outer and crown views, enlarged three diameters. Outline of jaw, natural size. Upper Gray Bull beds, Bighorn basin, Wyoming.

One jaw, No. 14695, has all the teeth except the tips of p_2 and i_1 in perfect preservation, affording a good comparison with the jaw of *C. scottianus* from a higher horizon. Two lower jaws from high up in the Gray Bull beds are intermediate between *C. latidens* and *C. angustidens* (infra). No. 15629, a well preserved upper jaw from the Bighorn Lysite affords satisfactory distinctions from the upper jaws of *C. scottianus* and *Microsyops.*

Osborn has referred *Pelycodus angulatus* of Cope to this genus. The specimen figured by Cope in 1885 appears to be specifically the same as *C. latidens.* The original type specimen, from the Wasatch of New Mexico, is lost, but Cope's figure and description of it do not accord well with this species, and it does not appear advisable to synonymize it. Two small species from the Wind River Lysite horizon described by Loomis in 1906 as *Notharctus palmeri* and *cingulatus* appear to me to be based, upon the teeth of *Cynodontomys,* probably *C. latidens.*

The species is distinguished from *C. scottianus* by somewhat smaller size and narrower teeth, $p\frac{4}{4}$ less molariform. The inner cusp (de^d) of p_4 is less distinct and lower, the posterior outer cusp (trittocone) of p^4 is smaller

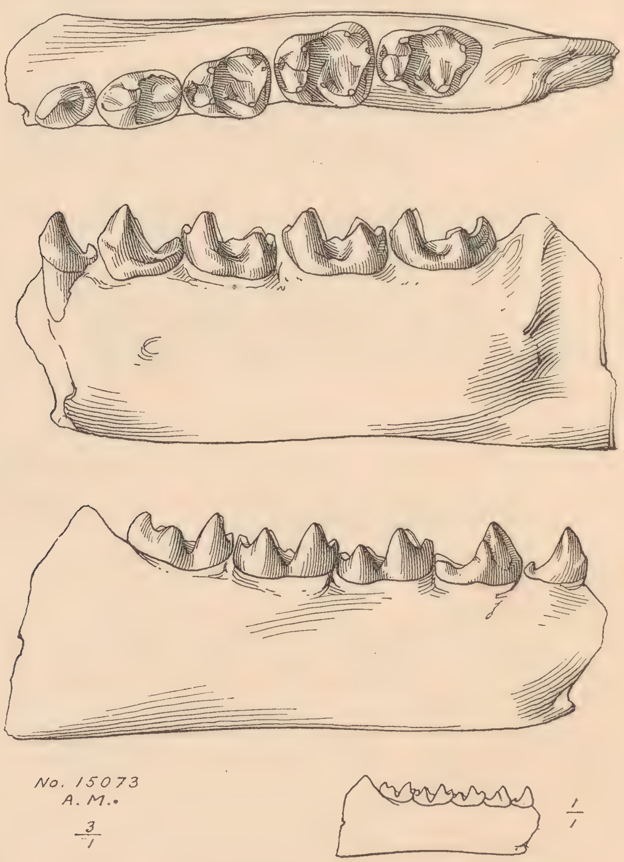

Fig. 47. *Cynodontomys angustidens,* lower jaw, inner, outer and crown views, enlarged three diameter. Outline of jaw, natural size. Type specimen, Gray Bull beds, Bighorn basin, Wyoming.

relatively, and the inner half of the tooth is not so broad, the posterior conule absent, the whole tooth more of the usual premolar type. Mesostyles are very rudimentary on m^{1-3}, none on p^4.

Cynodontomys angustidens sp. nov.

Type, No. 15073, lower jaws from the middle part of the Gray Bull beds, Bighorn. Referred specimens, Nos. 15079–82, all from the same horizon.

Distinctive characters: P_4–m_3 = 14.3 mm. P_4 narrow and oval, with smaller heel, entoconid rudimentary and deuteroconid small, molars somewhat smaller and relatively narrower than in *C. latidens*.

This species is distinctly more primitive and is not found above the Systemodon beds. Although the premolars are comparatively simple, they show no especial approach to those of *Mixodectes*, and appear to be derived from a quite different type, more that of ?*Oxyacodon* in the Paleocene. A jaw fragment with p_4–m_2, No. (coll. 1913), from the upper fossiliferous horizon in Clark Fork basin (lower Gray Bull beds) appears to represent a primitive mutant of this species, but part of the crown of the premolar is broken off and the presence of the metaconid cannot be determined.

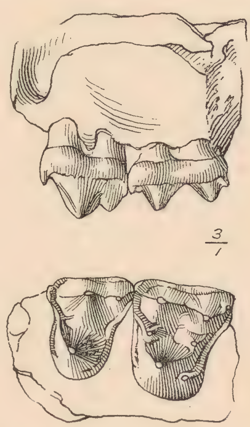

Fig. 48. *Cynodontomys angustidens*, fragment of upper jaw with fourth premolar and first molar, outer and crown views. No. 16875, Upper Gray Bull beds, Bighorn basin, Wyoming.

The fourth upper premolar has a small postero-external cusp, no conules, and less antero-posterior width than in the later species, and in general form is more clearly of premolar type. No mesostyle on m^1. In the lower jaw, p_4 has a small internal cusp not well separated, and a simple crested heel with very rudimentary inner cusp, in place of the bicuspid heel of the later species.

Family APATEMYIDÆ.

Insectivora or Primates with low-crowned bunodont tritubercular molars, premolars greatly reduced and p_4 simple; one anterior tooth, probably an incisor, greatly enlarged and more or less gliriform; other anterior teeth reduced or absent. Posterior mental foramen beneath m_1 or m_2.

The resemblance of the dentition in some genera of this family to that of *Cheiromys* (= *Daubentonia*) is closer than to any Insectivore. The teeth in some genera are very close to certain Eocene Tarsiidæ. On the other hand, the position of the mental foramen is peculiar to Insectivora (although not found in all of them) and the characteristic specialization of the front teeth is more commonly found in Insectivores than in Primates. An approach towards it is seen in *Tetonius*. The characters of the molars are such as might be found in any very primitive frugivorous mammal of minute size, whether Insectivore or Primate. The upper teeth, skull and skeleton are wholly unknown.

The Tarsiid resemblance is closest in *Trogolemur*, in which the front tooth is less enlarged, the position of the mental foramen further forward, and the premolar and molar teeth are more of Tarsiid type, nearest to *Omomys*. On the other hand *Phenacolemur* of the Lower Eocene differs widely from the Tarsiidæ and has no suggestion of Primate relationship in the molars. It appears to be rather nearly related to *Apatemys*, especially *A. bellus*. *A. bellulus* and *Uintasorex* of the Bridger are intermediate between the typical *Apatemys* and *Trogolemur*, but in form of teeth agree better with the latter.

It is possible that two different phyla are here confounded, *Trogolemur*, *Apatemys bellulus* and *Uintasorex* being successive stages of a diprotodont specialization derived from the Tarsiidæ, *Phenacolemur* and *Apatemys bellus* derivatives for some different stock. But it appears unwise to split up the family until we know more about it.

Trogolemur *Matthew* 1909.

Type, *T. myodes* from the Middle Eocene.

Generic characters: Molars simple, tritubercular with large basin heels, wide and low-crowned, p^d small internal, connate. Premolars three, short and wide crowded, simple, p_2 minute, p_3 small, p_4 moderately large with small imperfectly distinct heel. Anterior tooth enlarged, long-rooted, compressed, crown unknown.

This genus is much closer to Tarsiidæ in the construction and proportions of premolars and molars than is any other Apatemyid. The much greater enlargement of the anterior tooth and the peculiar position of the mental foramen are the chief distinctions. From *Smilodectes*, which it resembles less closely, it is also distinguished by the much greater reduction of p_3 and higher specialization of the anterior teeth, broader and shorter molars.

Schlosser[1] has referred *Trogolemur* to the Anaptomorphidæ. The reduction of the front teeth to a single greatly enlarged pair, as in *Cheiromys*

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[1] Schlosser, 1911, in Zittel's Grundzuge d. Pal., Vertebrata, p. 549.

(= *Daubentonia*), is the only objection to this reference. The central pair of incisors are slightly enlarged in *Omomys* and *Hemiacodon*, and in *Tetonius* the front tooth is very considerably, but not comparably to this genus. The enlarged front tooth is not well shown in my photographs of the type specimen although sufficiently noticed in the description, and Doctor Schlosser apparently failed to observe it, as he does not refer to it in defining the genus, and his definition of the family specifies "incisors and canines normal but the latter small."

Phenacolemur gen. nov.

Type, P. præcox infra.

Generic characters: Dentition $\overline{1.0.1.3.}$ Incisors enlarged procumbent, long-rooted, with long pincer-like crown. P_4 large, moderately compressed, simple with small heel. Molars with low trigonid and basined heel, no paraconids, m_1 and m_2 with two pairs of equal well separated cusps, m_3 with three pairs; a tendency to a transverse crest between each pair of cusps. Posterior mental foramen beneath m_1.

This singular little genus is represented by about a dozen specimens of lower jaws, pertaining to two or more species all from the Gray Bull and Sand Coulée horizons. The molars and premolars are widely different from those of *Trogolemur*, but *Apatemys* of the Bridger is to some extent intermediate. In *Apatemys* p_4 is reduced, almost vestigial; in this genus it is enlarged; the heel of m_3 in *Apatemys* is long with a single hypoconulid instead of the pair of cusps in *Phenacolemur;* m_{1-2} in *Apatemys* are shorter, wider and of more ovate outline, with the usual trigonid and heel as in Tarsiidæ. The upper molars referred to *Phenacolemur* are superficially very like those of *Paramys.* But the construction differs in detail, and the base of the zygomatic arch has the normal Primate or Insectivore position, instead of the anterior position characteristic of *Paramys* and all rodents. The front of the lower jaw is equally rodent-like, but the molars are of the normal tritubercular construction, and the incisor is rooted, the crown enamelled on both sides, and not scalpriform. The genus might be regarded as an ancestral stage in the evolution of simplicidentate rodents, but is too imperfectly known for such a speculation to have any value. It cannot be genetically ancestral, as it is a contemporary of *Paramys* in which the subordinal characters are fully developed.

Phenacolemur præcox sp. nov.

Type, No. 16102, lower jaw, from Sand Coulée beds of Clark Fork basin, Wyoming.

Specific characters: P_4–m_2 = 13.8 mm.; molars broader and more robust.

The type has p_4–m_2 complete, crowns of the last molar and incisor broken off. P_4 has a short, broad heel, but no anterior basal cusp or ridge. M_1 and m_2 have a low rather wide trigonid, the pr^d connected by anterior and posterior crests with the closely connate p^d and mc^d, a broad open basined heel with marginal hy^d and en^d. M_3 is nearly one half longer than m_1 or m_2, but its crown is not preserved in the type; No. 15075 from the Gray Bull beds shows that its construction was like that of *P. citatus* (infra).

Four lower jaws from the Sand Coulée beds and eight from the Gray Bull beds are referred to this species, although showing considerable variation in the anterior cheek teeth.

An upper jaw fragment, No. 16167, from the Gray Bull beds of Clark

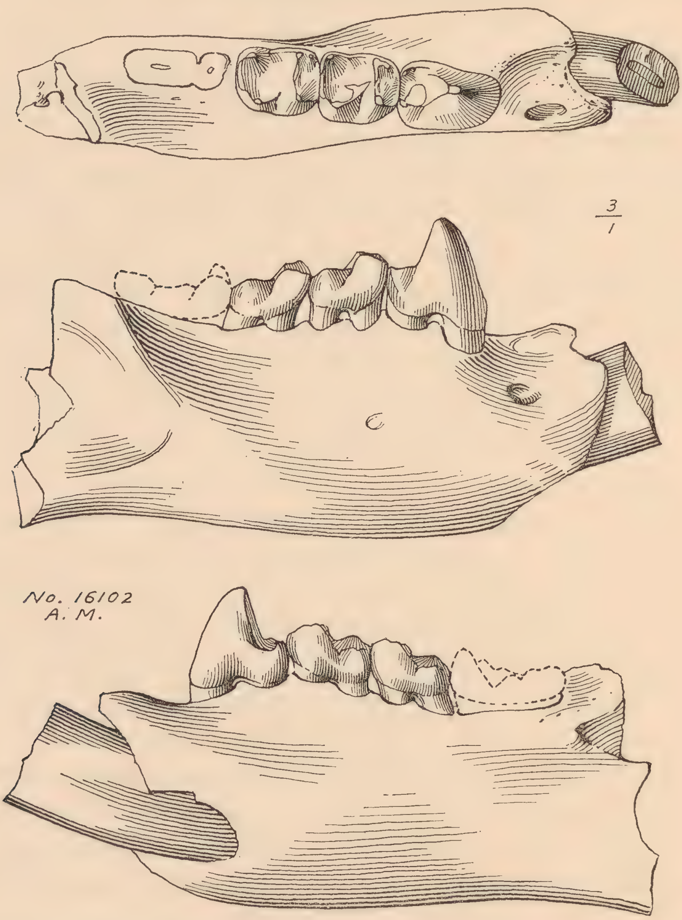


Fig. 49. *Phenacolemur prœcox*, lower jaw, inner, outer and crown views, Type specimen, Sand Coulée beds, Clark Fork basin, Wyoming.

Fork basin, is referred to this species as the molars conform in construction and fit very well with the lower molars of the type. They are rounded quadrate in outline, *paracone* and *metacone* well separated, external in position, roundconic in form and with a narrow outer cingulum. The *protocone* is connected in a heavy curved crest sweeping around the posterior side of the tooth as far as the posterior base of the metacone. The tooth construction has a very marked resemblance to that of *Paramys,* but in that genus the posterior crest ends internally in a distinct hypocone in the flank of the protocone; there is a heavy anterior cingulum, a distinct metaconule, and a metastyle. More important than these features is the position of the base of the zygoma, which in *Paramys* as in all rodents springs from the anterior end of the row of cheek teeth, whereas in the present specimen it clearly originates from the posterior part and projects backward, as it normally does in mammalia.

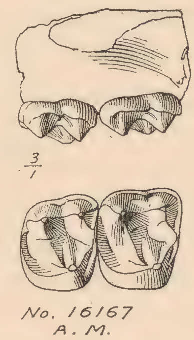


Fig. 50. *Phenacolemur præcox,* fragment of upper jaw with first and second molars, outer and crown views. Base of Gray Bull beds, Clark Fork basin, Wyoming.

Although these molars are not associated with lower teeth of *Phenacolemur,* they accord very well with the inferential construction of the upper teeth of that genus, from the characters of the lower teeth, and there is no other known genus of the Lower Eocene to which they could belong. They certainly are not rodent teeth, although superficially like them.

Phenacolemur citatus sp. nov.

Type, No. 15695, a lower jaw from the Gray Bull beds of the Bighorn, Wyoming basin.

Specific characters: P_4–m_3 = 11.8 mm. (approx.). P_4 smaller; anterior molars narrower and more elongate.

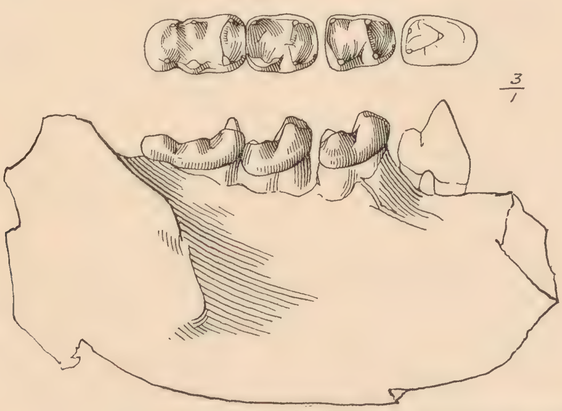


Fig. 51. *Phenacolemur citatus,* lower jaw, outer view, and crown view of teeth. Type, No. 15695, Upper Gray Bull beds, Bighorn basin, Wyoming.

The type shows the three molars. No. 15076 from the same horizon and locality has the three molars well preserved and part of the premolar aveolus and agrees closely with the type. A third jaw fragment with m_3 is also referred here.

Nothodectes dubius gen. et sp. nov.

Type, No. 16073, lower jaw, with p_3–m_3, from Clark Fork beds at base of bluff northeast of Ralston, Clark Fork basin, Wyoming.

Family ? Apatemyidæ.

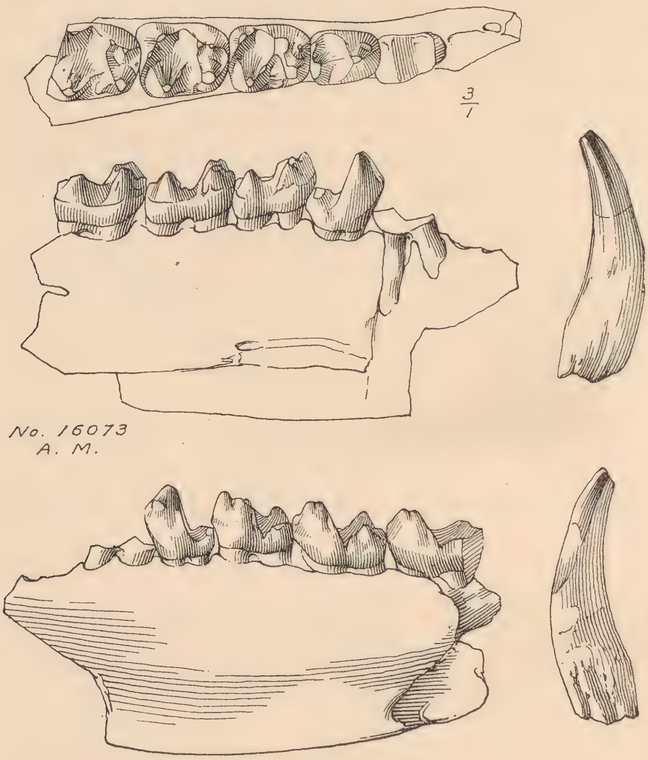


Fig. 52. *Nothodectes dubius*, lower jaw, inner, outer and crown views, and outer and inner views of an (?) incisor found associated. Type specimen, Clark Fork beds, Clark Fork basin, Wyoming.

One anterior tooth enlarged, others smaller or absent. Premolars probably two, a diastema in front of p_3. P_3 two-rooted, crown broken off; p_4 short with high stout protoconid and short wide heel. Molars with short trigonid of two principal cusps moderately connate, and large, deeply basined heel. Paraconid vestigial except on m_1, metaconid distinctly twinned on all molars, entoconid nearly equalling hypoconid, no hypoconulid (unless on m_3 where it is not preserved). Mental foramen indicated as beneath posterior end of m_1.

The ordinal and family position of this genus are very doubtful. The construction of the molars is not unlike some of the Tarsiidæ but is perhaps somewhat nearer to *Phenacolemur*. But the characteristic heel of this genus is not preserved in the type and only specimen of *Nothodectes*. The enlarged front tooth is indicated only by a small portion of the alveolus of the root; a slender caniniform tooth associated with the type specimen may belong in this alveolus but cannot be positively fitted, and is smaller than would be expected. A well marked diastema in front of p_3 indicates probably that the anterior premolars were absent; and the position of the mental foramen is probably but not certainly indicated as beneath the posterior end of m_1. These characters accord best with the Apatemyidæ. While clearly distinct from any described genus the position of *Nothodectes* can only be ascertained by more complete specimens. It is of interest as coming from the Clark Fork beds, but does not show near affinities to any known Paleocene genera.

Explanation of Plate XV.

Arctostylops steini, lower jaw, inner (lower figure), outer and crown views. Enlarged to five diameters. Type specimen, No. 16830, base of Gray Bull beds, Clark Fork basin, Wyoming.

Arctostylops steini. $\times \frac{5}{1}$.

56.81.1(1161:78.9)

Article XV.—ON REPTILES OF THE NEW MEXICAN TRIAS IN THE COPE COLLECTION.

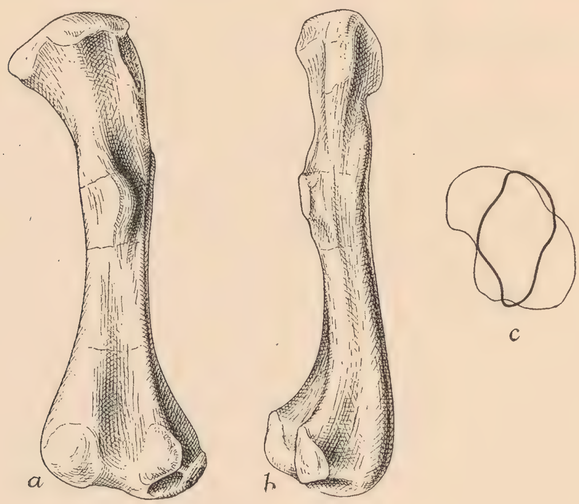
By Friedrich von Huene.

Some time ago Professor H. F. Osborn and Dr. W. D. Matthew suggested that I reëxamine the Triassic Cope Collection now in the possession of the American Museum of Natural History in New York. After having seen the collection I gladly consented to accept that honor and the collection was accordingly forwarded to Tübingen for this purpose. With the exception of one skull the remains are very fragmentary and in some cases it is hardly possible to know which specimens are Cope's types and which ones of the others belong with them. As several skeletons of Phytosaurs have been found in Wyoming and New Mexico during the last few years and have not yet been described it is necessary to be very careful in describing single scattered Phytosaurian bones. Therefore I shall only redescribe and figure Cope's type specimens and bones surely belonging with them. At the present time only the describer of Prof. Williston's new skeletons would be able to do more.

? Parasuchia.

1. **Typothorax coccinarum** *Cope.*

Femur: The femur (Fig. 1), 22 cm. in length, most nearly resembles that of *Thecodontosaurus antiquus.* The main difference is the extreme thickening of the distal end. The trochanter quartus is very much more prominent than in any other known Pseudosuchian or Phytosaur, but it makes the characteristic angle always seen in the feeble Phytosaurian trochanter. The proximal end is not quite so broad as in many Phytosaurs; in this respect it more nearly resembles Pseudosuchians; it is also not so flat from the inner side as in many Phytosaurs. The trochanter minor is rather strongly developed, but lateral to it there is a groove as in many Phytosaurs, only smaller. Even a trochanter major is developed in this femur, but not quite so much as in *Thecodontosaurus.* The distal half of the bone is not so much curved (Fig. 1c) as is usual in Phytosaurs, but the turning of the distal extremity is about the same as in other Phytosaurs. This part of the femur is not only very thick but also extraordinarily broad. The articular faces of the condyles are very much rounded and the sharp lower prominence of the lateral condyle is still about 2 cm. away from the lateral border of the bone. In other Phytosaurs the condyles are not so distinctly developed.



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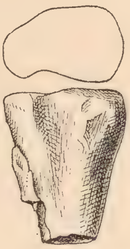

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Fig. 1. *Typothorax coccinarum* Cope. Right femur; *a* posterior, *b* lateral view, *c* upper (thick) and lower (thin) contour, one upon the other to show the twisting of the distal end. × ½. (Type: Cope, l. c. 1887, pl. 1, fig. 3).
Fig. 2. *Typothorax coccinarum*. Proximal end of tibia. × ½.

The right femur is quite complete. In the left one the distal end is missing; the bone is still connected by matrix with a rib, a dorsal and a caudal dermal scute.

The measurements of the right femur are:

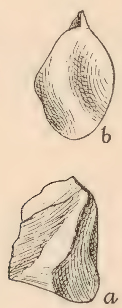
Length	22	cm.
Transverse diameter of the head	6	cm
Length of trochanter quartus	4	cm.
Distance of its lower extremity from the proximal end of the bone	10	cm.
Diameter of the shaft below trochanter quartus, transverse	3	cm.
Diameter of the shaft below trochanter quartus, antero-posterior	2.2	cm.
Diameter of the condyles, transverse	8	cm.
" " " " antero-posterior at medial condyle	4	cm.
" " " " " " lateral "	5.4	cm.
" " " " " " groove	3.4	cm.

Tibia: A head of a bone (7 cm. long), with the greater part missing, I take for the proximal end of a left tibia. The bone is quite hollow at the break (Fig. 2).

Antero-posterior diameter of articular face	5.5 cm.
Transverse " " " " in posterior part	3.3 cm.
Greater diameter of shaft at break, estimated	3.3 cm.
Smaller " " " " "	1.8 cm.

Metatarsals: There are a number of fragments of metatarsals with distal articular faces of about the type of other Phytosaurs. They are quite straight with oval section of the shaft and much thickened distal articular end.

Scapula: With these bones is an articular end of a right scapula (Fig. 3). It is very much thickened near the articular faces, but very thin farther on.



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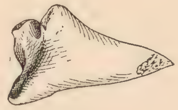

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Fig. 3. *?Typothorax coccinarum.* Articular extremity of scapula. × ½.
Fig. 4. *?Typothorax coccinarum.* Left cervical rib. × ½.

There are the characteristic double facets for the coracoid and the humerus; both of them together have an oval contour, the greater diameter being 5.3, the smaller 3.8 cm.

Ribs: There are a few fragments of vertebræ, but not enough to give any idea of their character. One left cervical rib (Fig. 4) is of the Parasuchian type, but very broad.

The thoracic ribs are of a very singular type. They are flat and broadened probably to a breadth equal to the length of the vertebra they belong to. Each rib is covered by a sculptured dermal scute corresponding in breadth and length with the rib, somewhat like *Aëtosaurus ferratus* or *Stegomus arcuatus.* Two ribs covered by such scutes have, together, a breadth of 7.5–8. cm. (Fig. 5 and 6). In their thickest part the ribs only measure 1.5 cm. This thickening, being the main part of the rib itself, and prominent only on the inner side, is about 3 cm. broad and the distal end of it curved into one of the corners which is probably the posterior one. In that specimen the rib does not naturally end by becoming more and more slender, but the whole breadth is just obliquely cut off. The ribs are not evenly

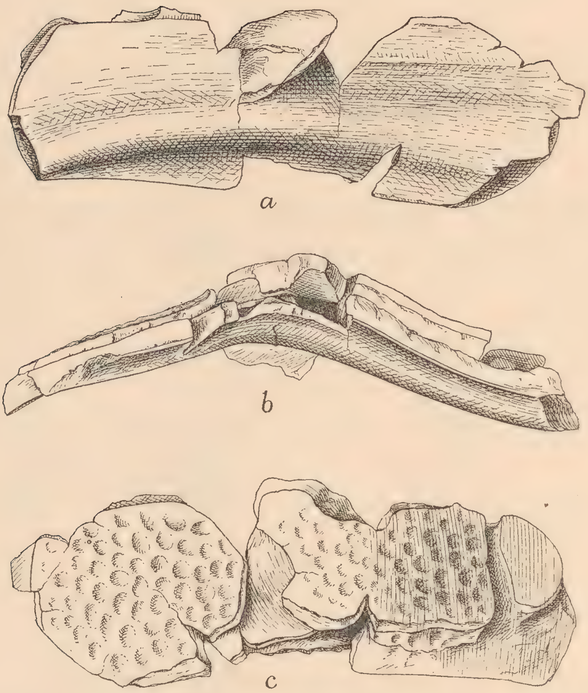
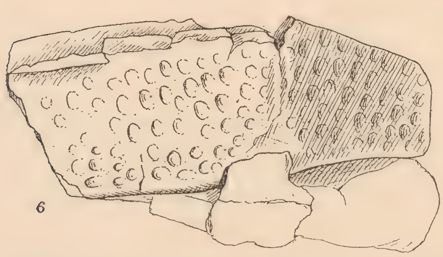


Fig. 5. *Typothorax coccinarum.* Fragment of dorsal rib; *a* from below, *b* from behind, *c* from above, covered with dermal scute. × ½. (Type: Cope, l. c. 1887, pl. 1, fig. 1.)



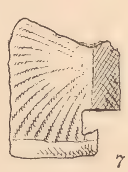


Fig. 6. *Typothorax coccinarum.* Fragment of another dermal scute covering a rib, from above. The left femur is attached at the side and a smaller scute (fig. 7) below. × ½. (Type: Cope, l. c. 1887, pl. 1, fig. 2).

Fig. 7. *Typothorax coccinarum.* Imperfect lateral (?) scute, attached below, scute shown in fig. 6. × ½.

curved but seem to be in two planes, the probably shorter medial part of the rib is straight, then comes a slight angle downwards and the rest is straight again. In *Phytosaurus, Mystriosuchus* and *Rutiodon* the ribs are not broadened at all and we do not yet know the thoracic ribs of *Aëtosaurus ferratus* nor those of *Stegomus arcuatus.* So this case is still a single one in Parasuchians, slightly resembling some of the turtles.

Dermal scutes: The back is covered with transversely long and relatively narrow (8 cm. broad) sculptured dermal bones. These scutes are not connected with the ribs; there is always matrix between. Their sculpture consists of small (about 5 mm. diameter) shallow pits near each other. They are arranged in a crypto-radial order with the center of radiation in the middle of the anterior border just above the angle of curvature already mentioned. The thinner posterior border is marked by a raised smooth and narrow strip. Each scute probably covered its anterior neighbor in overlapping that thin border, in the manner of tiles. The more complete one of the scutes is 25 cm. long and 8 cm. broad.

There are still 4 other scutes, three of which belong to the tail. One of them (Fig. 7) on the inner side of the rib, connected by matrix with the left femur, is possibly one of the lateral rows of scutes of the body or possibly of the beginning of the tail; it is longer in axial direction than in transverse; the posterior border is the same as in the medial dorsal scutes; its sculpture consists in radially arranged pits and fossæ, radiating from a centre at the broken anterior border.

The smallest one (Fig. 8) of the three remaining scutes is also a lateral one, but is from the tail. Except for the size it is similar to the one just described.

The two other scutes, of different size, are of the upper medial rows of the tail (Fig. 9 and 10). They are strongly curved. Their form is rectangular, the smaller one being subquadrate, the larger one longer in transverse direction. Their posterior border is formed as in the dorsal scutes. Near the middle of the anterior border is a high spine-like elevation from which the sculpture radiates.

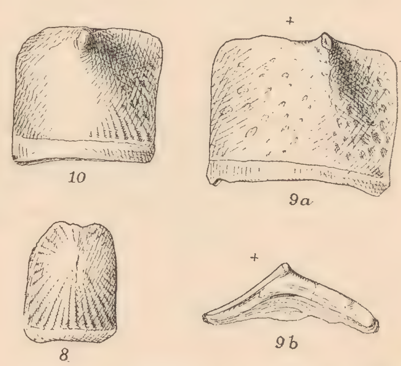


Fig. 8. *Typothorax coccinarum.* Lateral (?) scute. $\times \frac{1}{2}$.

Figs. 9 and 10. *Typothorax coccinarum.* Tail scutes; 9*b* showing curvature. $\times \frac{1}{2}$.

Classification: It is difficult to say whether *Typothorax* should be classified with the Pseudosuchians or with the Parasuchians. The resemblance of the dorsal shield with *Aëtosaurus* is great, but *Phytosaurus* has a shield of the same form; femur and scapula go, perhaps, a little better with the

Parasuchia than with the Pseudosuchia, but there is no unmistakable criterion. *Typothorax coccinarum* may possibly be related to *Stegomus arcuatus* (not to *S. longipes*). Probably a new family should be established, the Typothoracidæ, from the characters of the ribs. I leave it open to the future to decide whether *Typothorax* belongs with the Pseudosuchia or with the Parasuchia, but I personally have rather the impression that it is a Parasuchian.

Parasuchia.

2. **Phytosaurus buceros** *Cope.*

Of this species there is but one skull, without lower jaw (No. 2318). It is nearly complete (Fig. 11), only the top of the snout being missing. Its length is now 70 cm. In Cope's time there still existed posterior teeth

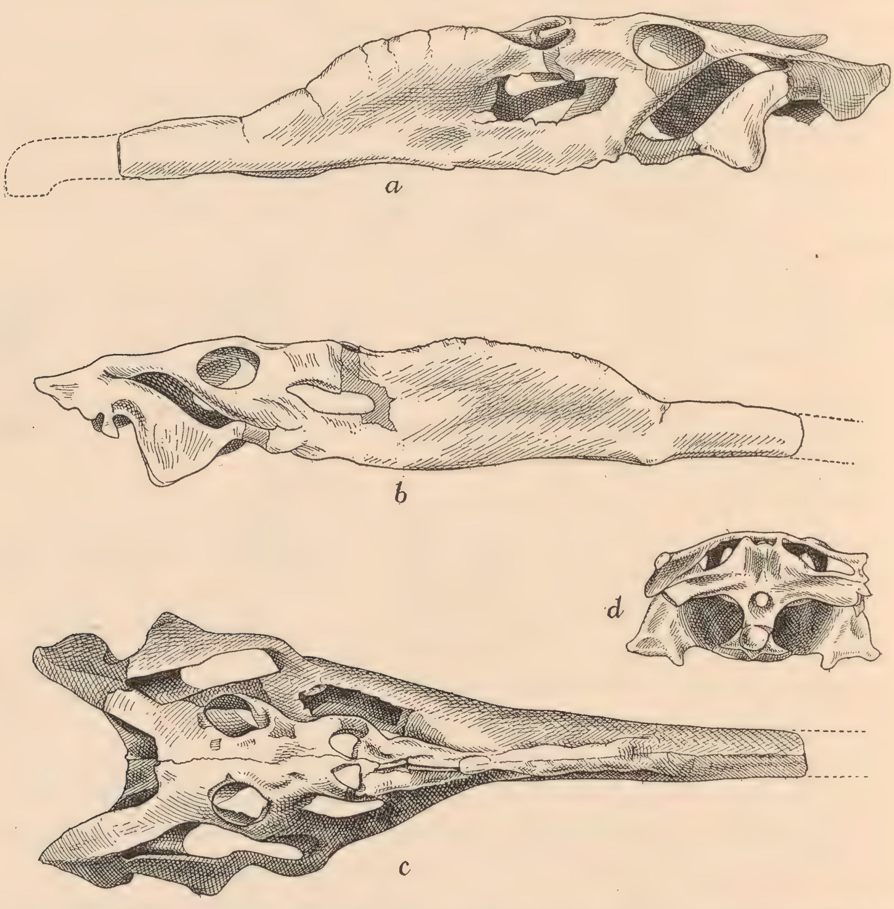


Fig. 11. *Phytosaurus buceros* Cope. Skull, type specimen; *a* from left side, *b* from right side, *c* from above, *d* from behind. × ⅛.

with compressed denticulate crowns, but they are not present now. The preservation of the skull, in details, is rather rough and hardly shows any sutures, but the external form is very well seen. Cope also described the braincast.

The arrangement of the openings is most like that of *Phytosaurus*, especially *P. kapffi*. The nares are as in that form above the middle of the preorbita. In *Mystriosuchus* and in *Rutiodon* the lower temporal fenestra is much bigger and broader than in *Phytosaurus kapffi* and in this species. The same is to be said of the upper temporal opening. Here it is not visible from above in contrast to *Mystriosuchus* and *Rutiodon* and is still more different from *Palæorhinus* and far more from *Mesorhinus*. *Angistorhinus* is of the *Mesosuchus* type. The nasal openings are little broader than in *Phytosaurus kapffi;* they are not situated in a special elevation, as, for instance, they are in *Angistorhinus*, but their borders lie nearly in the same plane as the frontals and the posterior medial part of the nasals; they are only slightly inclined forward. In front of the preorbital openings the snout becomes very much compressed and raises higher than the anterior border of the nares. The protuberance has a length of about 25 cm. from the border of the nares; from that point the snout is low as in *Mystriosuchus*, *Rutiodon*, *Angistorhinus* and *Palæorhinus*. Only 14 cm. of that part are still preserved and I suppose, for reasons given below, that 10 more centimeters are missing of the original extremity of the snout. I think I am able to trace the anterior end of the maxillæ from the palatal side, because on the right and on the left side I see the suture obliquely crossing the ridges inside the alveoli, but at the place where it should cross the tooth-line there is a break on both sides filled up with plaster. But there can hardly be a doubt about the very end of the maxillæ. The most anterior two or three alveoli of the maxilla are a little smaller than the others in front and behind. I count 23 alveoli in the maxilla, 15 or 16 more alveoli are preserved in the premaxilla (one side). In *Phytosaurus kapffi* and in *Mystriosuchus planirostris* and *plieningeri* there is about the same number of teeth in the maxilla and in the premaxilla. From the great resemblance to *Phytosaurus kapffi* I suppose the same is true in this species, which makes 7 or 8 teeth, or about 10 centimetres missing. In restoring the snout in this manner the aspect will be very different from what Jaekel thought in Sitz. ber. Ges. naturf. Freunde, Berlin. No. 5, 1910, p. 215, f. 8. The high and the low part of the snout are of about equal length.

Phytosaurus buceros is not so primitive as *Palæorhinus*, because the snout is relatively longer and the nares are situated farther back, but not so far as Jaekel suggests. *Palæorhinus* seems to be what we should postulate for the precursor of *Angistorhinus*, *Rutiodon* and *Mystriosuchus*, though it is contemporaneous. The group of these few genera is characterized in the skull by a broad infratemporal fenestra and a relatively great supratemporal fenestra, cutting farther into the parietal roof; in the body they are characterized by subquadrate and scale-like dermal scutes. They may be called the Family Mystriosuchidæ. *Phytosaurus kapffi* and *buceros* have long narrow infratemporal fenestra, very small and narrow supratemporal opening, relatively longer and more backwardly directed squamosal rami, narrower and more horizontal preorbital openings; the dorsal dermal scutes are in transverse direction long and narrow strips, touching each other like tiles; these scutes most nearly resemble Aëtosaurus. This family may be called Phytosauridæ (*s. str*). Both of these families are preceded by the Stagonolepidæ as characterized by the author (l. c.), consisting of *Stagonolepis* and *Mesorhinus.*

There is no doubt that *Phytosaurus buceros* is very nearly related to *Phytosaurus kapffi,* much nearer than to any other known form. One difference is in the formation of the snout; the low anterior part is very much longer than in *Phytosaurus kapffi,* but there also the very extremity of the snout is really low. The lower part of the snout being relatively longer than in the other species would not be enough for a generic difference. So in the present state of knowledge I do not see any reason for establishing a new genus for *Phytosaurus buceros* as Jaekel did ("*Metarhinus*" l. c. p. 220).

From the resemblance of the skull it is supposed that the dermal scutes were of the same type as in *Phytosaurus kapffi.* Now *Typothorax* has such an armature, but it also has at the same time an extremely aberrant type of ribs and peculiar skeleton bones with extraordinarily thickened articular ends. It is absolutely impossible to declare *Phytosaurus buceros* and *Typothorax coccinarum* as belonging to the same species or even genus. I only say that this is the only true Phytosaurian skull hitherto known in America, and on the other hand *Typothorax* is the only type of armature much resembling *Phytosaurus kapffi* (except the smaller *Stegomus arcuatus*), therefore while this idea, that *Typothorax and Phytosaurus* are identical, may arise I do not think it is very probable.

3. **Episcoposaurus horridus** *Cope.*

In the Triassic Cope Collection many bones and fragments are marked with the same number (2307) as the type specimens; that means they come from the same place. The boxes containing them are also marked in Cope's handwriting, as *Episcoposaurus horridus,* but nevertheless they belong to different Parasuchia. It is impossible to take out only those bones described by Cope as *Episcoposaurus,* because even they belong to at least two quite different animals. Cope describes as belonging to this species: "two caudal vertebræ, a proximal and a distal one; one humerus; two ulnæ; a femur lacking the condyles; a proximal part of a tibia; the distal part of a fibula; a calcaneum and a number of dermal bones. The only part of the skull probably belonging to this animal is a splenial bone." The named parts of the fore leg are so very much smaller than those of the hind leg that from all experience in Parasuchia it seems impossible that the animal could have been so disproportionate. The two caudal vertebræ and the splenial (two splenials) may belong to the same animal as the hind leg. The dermal bones of Mystriosuchian type may possibly belong to the latter too, but there are different types of scutes and it is hard to say whether they really all did belong to different parts of the same animal (species).

In consequence I shall eliminate humerus, radius (which is also there) and ulna from the determination *Episcoposaurus horridus* and shall take the bones of the hind leg as the real type of this species, appending also the splenials, the two caudals and possibly some of the scutes.

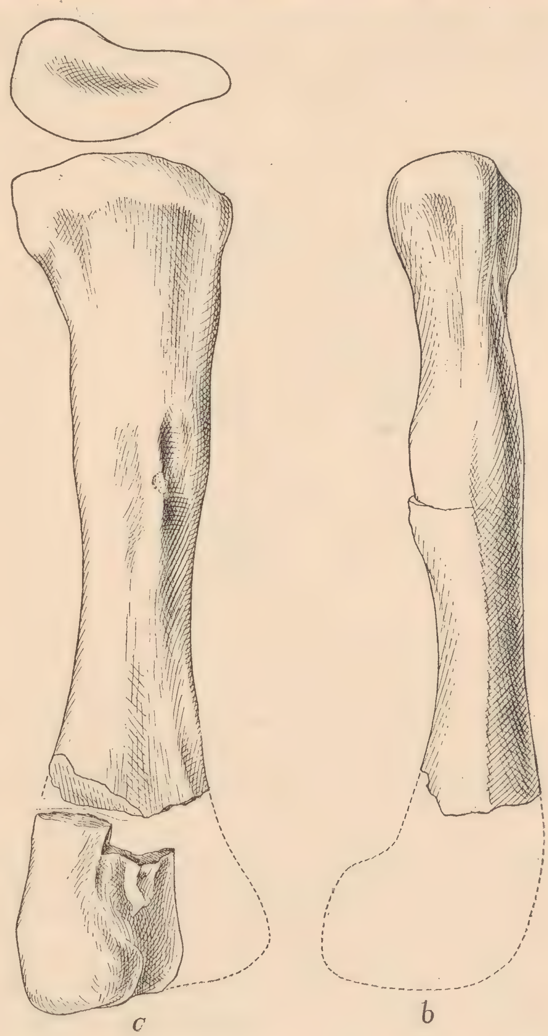
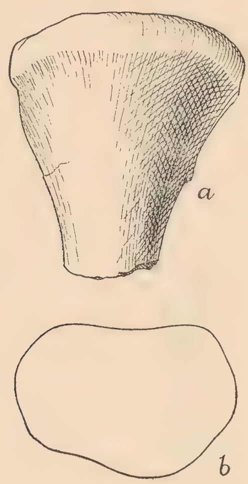


Fig. 12. *Episcoposaurus horridus* Cope. Right femur in two pieces; *a* from behind with upper view. *b* lateral view. $\times \frac{1}{2}$. (Type: Cope, l. c. 1887, p. 215.)

Femur: As demonstrated by Cope the femur is a thick and strong bone, but unusually straight for the distance preserved in one piece; there is also the greater part of the distal extremity with part of the condyles of the same right femur, neglected by Cope (Fig. 12). And this taken together with the greater piece, though they no longer fit together, shows that the distal end of the femur had a slight curvature and the turning characteristic in Parasuchia. The trochanter quartus is relatively well marked and the thick head is only very little expanded, not even quite so much (and straighter) as in *Rutiodon manhattanensis* von Huene. The length of the greater fragment is 31 cm. The original complete length was probably, approximately, 40 cm.

Tibia: There are three pieces of the tibia, the head of probably a left bone, a small bit of the shaft and the distal extremity of a right tibia. The last had been taken by Cope for the distal end of a fibula. The diameters of the head are 11 cm. and 7.3 cm.; the shaft 12 cm. below the head has 3.2 and 4.5 cm. diameter. That shows a relatively thick head and thin shaft,



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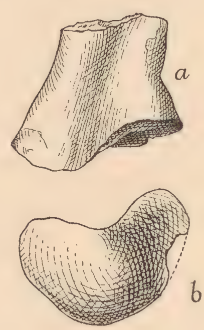

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Fig. 13. *Episcoposaurus horridus.* Proximal end of right (?) tibia, medial and upper view. × ½. (Type: Cope, l. c. 1887, p. 216.)

Fig. 14. *Episcoposaurus horridus.* Distal end of right tibia; *a* lateral, *b* lower view. × ½. (Type: Cope, l. c. 1887, p. 216. "Fibula.")

(Fig. 13), which is very different from *Rutiodon manhattanensis* and also *R. carolinensis.* The contour of the articular face resembles that of a bean; at the slightly concave side of it the shaft is flat or even slightly concave in its beginning; the opposite side is strongly convex. The latter is the medial, the former the lateral side. I take the bone as a right one, because one of the short sides of the head (the posterior one) is projecting from the shaft a little more than the other one (the anterior).

The distal end of the same right tibia (Fig. 14) shows a character not yet well known in Parasuchia, the division of the distal end into two processes, the posterior one going straight down, the anterior and shorter one projecting laterally. It strikingly resembles the Saurischia though not so broad as is usual in that group. A Phytosaurian tibia figured by H. v. Meyer (Palæontographica VIII, 1859. Tb. 42, f. 1) shows the same tendency only the epiphysis is missing there.

From these fragments it is impossible to determine the length of the tibia.

Calcaneum: This is the most striking bone of the whole set, because at first impression it seems to have a likeness to the true Crocodilian calcaneum. Cope says: "The calcaneum has the form usual in crocodiles and especially in Belodontidæ." As far as I know a Parasuchian ("belodont") calcaneum has never been found, or at least described, except this one, and from crocodiles it differs quite essentially. The Crocodilian calcaneum has three faces of contact (with fibula, distal tarsals and astragalus); this one (Fig. 15) lacks an articulation with the astragalus and the tuber has not the form usual in crocodiles; there is rather a slight resemblance to the calcaneum of *Hallopus* (cf. Huene: Beiträge zur Geschichte der Archosaurier. Geol. u. Pal. Abhandl. 13 (17), 1. 1914). The contour of the calcaneum in anterior aspect has a resemblance to that of a Pelycosaur rather than to a later reptile. It is known that the Phytosaurian skull in many points has great similarity to Pelycosaurs. Through the kindness of Mr. D. M. S. Watson of the British Museum I am enabled to give figures (Fig. 16) of the calcaneum of *Erythosuchus africanus* Broom which is also enlarged, but in another way than in crocodiles and *Episcoposaurus*. It does not possess a tuber, but is a broad and thick plate rather similar to primitive reptiles.

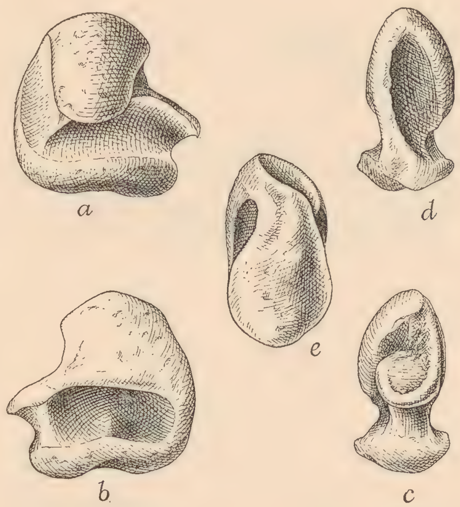


Fig. 15. *Episcoposaurus horridus.* Left calcaneum; *a* from behind, *b* front view, *c* medial view; *d* lateral view, *e* from below. $\times \frac{1}{2}$. (Type: Cope, l. c. 1887, p. 216.)

The calcaneum of other Parasuchia is not yet known, but it is probable that all of them possessed large tarsals of the first row as is also indicated by the cited tibia of *Phytosaurus kapffi.*

This kind of calcaneum as well as many other points illustrates the convergent adaptation in Parasuchia and Crocodilia (Fig. 17), which can never be derived directly from each other. It is a distinct development by itself.

The calcaneum, I suppose, is a left one. The tuber extending laterally backwards and upwards is flat from the latero-anterior side and has a cushion-like thickening at the postero-medial side, for fixation of the tendons. The upper articular face of the tibia is quite flat, the lower one is convex and has its anterior border more rounded and higher than the posterior one. The greatest vertical extension at the tuber is 9 cm., the transverse direction measures about the same.

Caudal vertebræ: They are of course not very characteristic of the species. They are both of the same length, 7.2 cm. (at the neuro-central limit). One of them, a centrum only, is of the anterior third of the tail (Fig. 18).

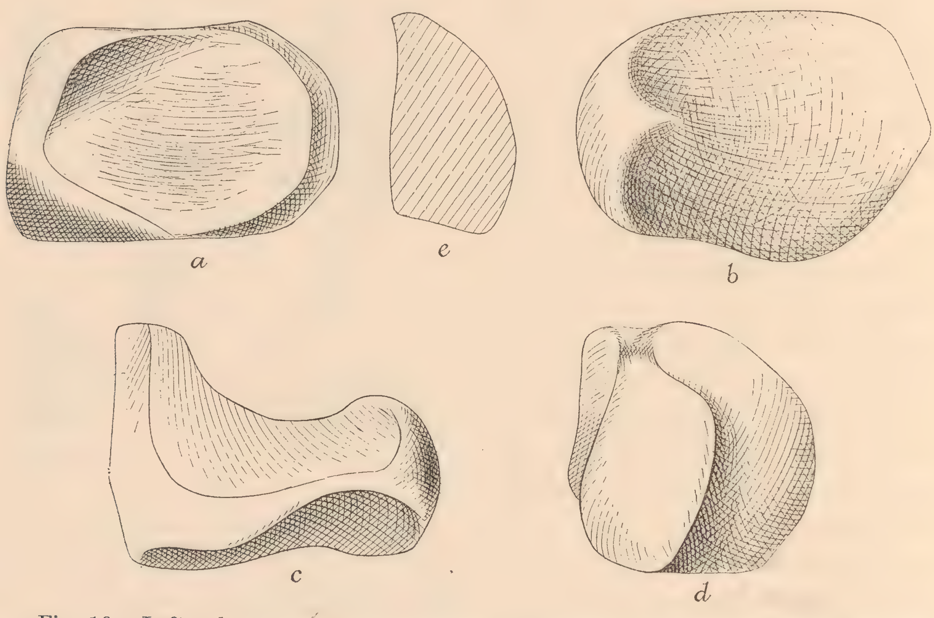
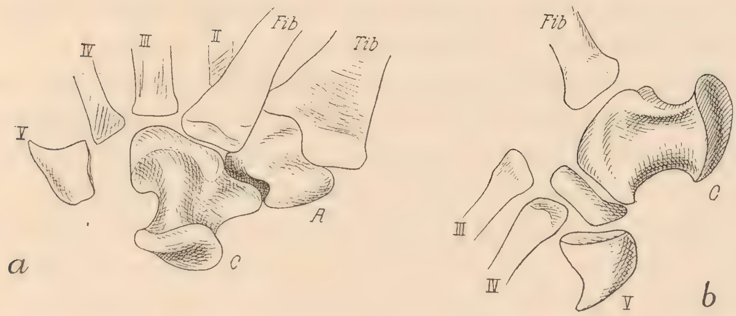


Fig. 16. Left calcaneum of *Erythrosuchus africanus* Broom, in the British Museum, Natural History (Coll. Watson). London; *a* anterior view, *b* posterior view, *c* upper view, *d* lateral view, *e* from below. × ½.

Its posterior articular face measures 5 cm. in vertical and the same in transverse direction. The section of the vertebra in the middle is cuneiform, rather sharp below. It has distinct articular faces for the hæmapophysis at the posterior end, but nothing of that kind at the anterior end. The neural canal is deep. Its neural arch possessed big transverse processes as shown by the deep curvature of the contact line of the centrum and arch.

The posterior vertebra may be the beginning of the last third of the tail (Fig. 19). It still shows the greater part of the neural arch without any trace of a transverse process. The anterior articular face measures 3.2 cm. in vertical and in horizontal direction. There is a median longitudinal ridge



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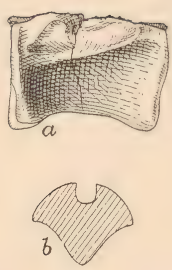

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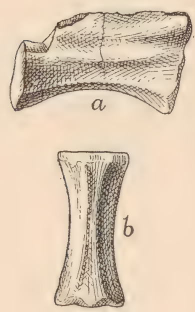

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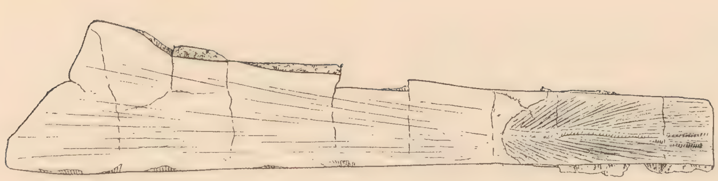

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Fig. 17. Left foot of *Crocodilus niloticus* showing calcaneum (*C*); *a* from above and behind, *b* lateral aspect. × ½.

Fig. 18. *Episcoposaurus horridus.* Anterior tail vertebra with transverse section. × ½. (Type: Cope, l. c. 1887, p. 213.)

Fig. 19. *Episcoposaurus horridus.* Distal tail vertebra, two views. × ½. (Type: Cope, l. c. 1887, p. 213.)

Fig. 20. *Episcoposaurus horridus.* Medial view of splenial with symphysis. × ½. (Type: Cope, l. c. 1887, p. 213.)

below, and lateral to each side. From here upward the vertebra becomes narrower. Instead of a neural spine there is a broad and low lamella. At the posterior border of the centrum are two distinct small facettes for the hæmapophysis, but none at the anterior end.

Splenial: Two big splenial bones are preserved, 35 and 32 cm. long; they are the right and the left. The smaller (left) one shows distinctly (and I think the longer does too) a symphysial face of 9 cm. in length; the anterior extremity of it is missing (Fig. 20). The ventral border of these bones is 2–2.5 cm. thick. In the anterior part they are 3.5, in the posterior 7 cm. high. They belong to a jaw at least 90 cm. long. Possibly these splenials do not belong to the same individual, as one of them seems to be a very little larger in every dimension.

Dermal bones: All scutes lying with *Episcoposaurus* bones (but also with

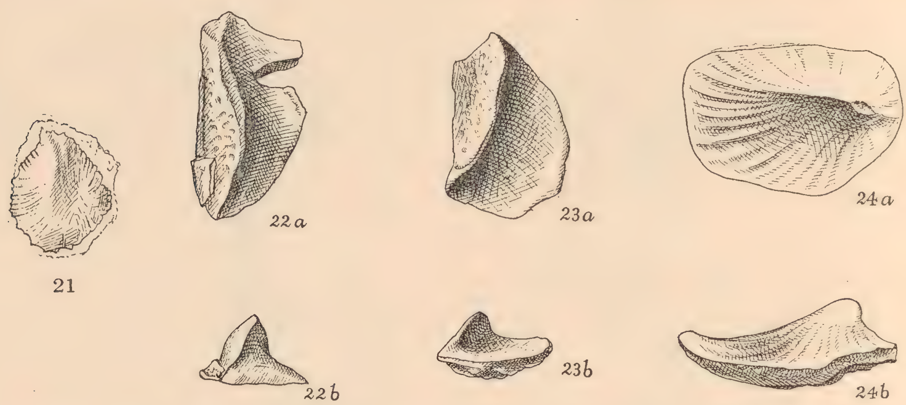
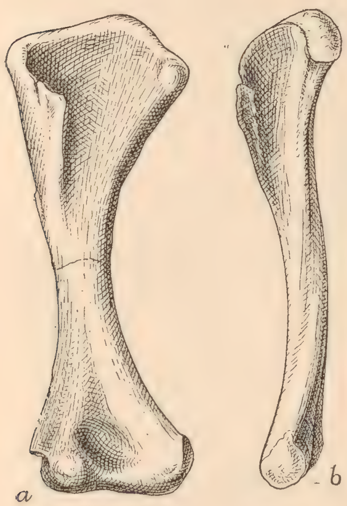


Fig. 21. ?*Episcoposaurus horridus.* Dermal scute from the throat-shield. × ½.
Figs. 22–24. ?*Episcoposaurus horridus.* Dermal scutes. × ½.

other Phytosaurs mixed with them) are of the Mystriosuchid type. If one of them really belonged with *Episcoposaurus* it is to be expected that *Episcoposaurus* had a low snout in its skull. One of these scutes is a polygonal one belonging with the throat-shield (Fig. 21). Two others, rather small, possess a very high, steep and sharp longitudinal ridge. Two others (Fig. 22–23) of rather tile-like form are badly preserved. The biggest and best one of the scutes (Fig. 24) has a high longitudinal spine-like elevation, rising obliquely and having its highest point near the short border of the scute; a slight sculpture radiates from there.

Only new discoveries of *Episcoposaurus* will make it possible to determine which of these scutes belong with it; whether the above described scutes are all from different parts of the same animal, which I doubt, or whether they belong to different animals.

The bones of the front leg, also described by Cope as *Episcoposaurus horridus,* belong to a small Mystriosuchid phytosaur. There are also femur and vertebræ apparently belonging together with the humerus, etc. (Fig. 25–27). Also in series No. 2308 the same species is represented by vertebræ, scapula, ulna, radius, femur, etc. It is possible, if not probable, that these smaller bones belong to Cope's "*Belodon*" *scolopax.* The anterior part of skull, which he so named, seems to be lost now, but it was found at about the same place with all the other remains. This skull was of the Mystriosuchid type and rather small, the snout being extremely low and



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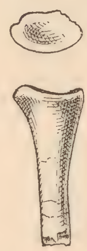

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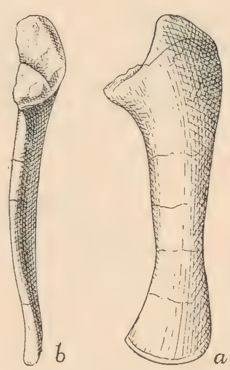

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Fig. 25. *Episcoposaurus horridus.* Series No. 2308. Right humerus; *a* front view. *b* medial view. × ½. (Type: Cope, l. c. 1887, p. 22).

Fig 26. *Episcoposaurus horridus.* Series No. 2308. Upper part of radius. × ½. (Type: Cope, l. c. 1887, p. 215.)

Fig. 27. *Episcoposaurus horridus.* Series No. 2308. Left ulna; *a* posterior, *b* lateral view. × ½. (Type: Cope, l. c. 1887, p. 215).

tiny. From these indications the bones mentioned here, and possibly coming from the same spot, could very well belong to this skull, but without new finds there is no possibility of being sure of that.

The series numbered 2312, also coming from about the same place, belongs to another phytosaur also of Mystriosuchid type as easily determinable from the nicely preserved vertebræ. They have a darker red color, having been imbedded in a soft red clay. All the bones of the set No. 2407, No. 2308 and No. 2310 are partly incrusted with gray, greenish and purple silicious clay with dark silicious grains.

CŒLUROSAURIA.

4. **Coelophysis longicollis, bauri** and **willistoni** *Cope.*

Figs. 28–64.

Coelophysis seems not to be uncommon in the New Mexican Trias. In the Cope Collection are several series of bones and fragments and there were also several vertebræ mixed with the remains of *Typothorax* and *Episcoposaurus.* In 1906 I redescribed (l. c.) and figured the most important ones of the remains of *Coelophysis longicollis* and *bauri,* when Prof. Osborn sent me splendid casts of them.

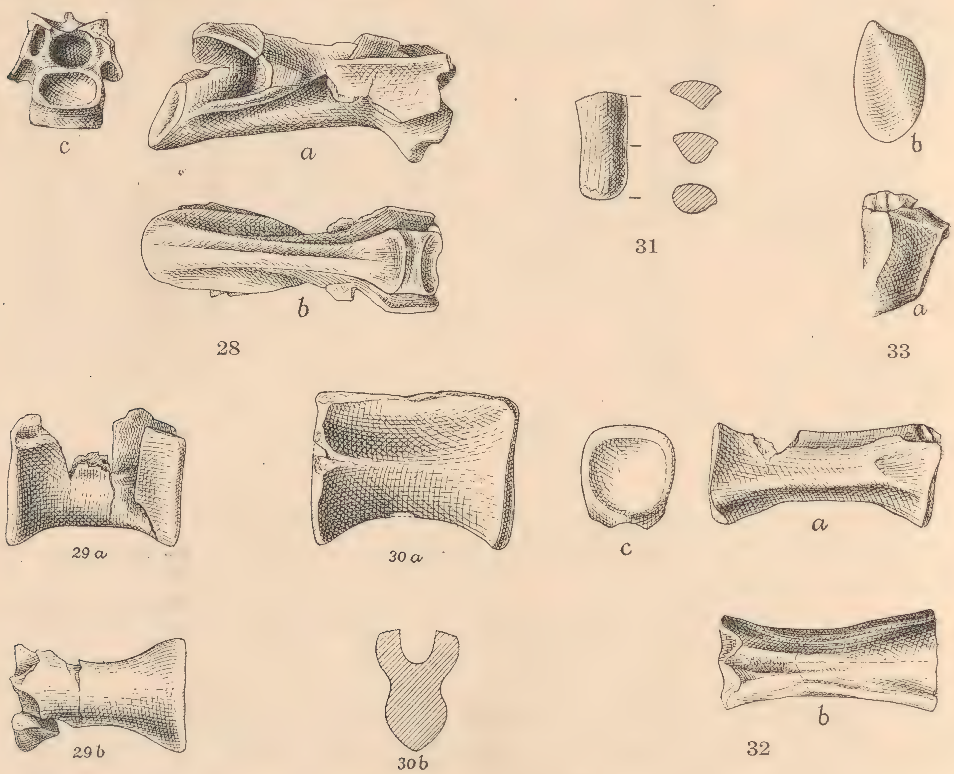


Fig. 28. *Cœlophysis longicollis* Cope. Epistropheus; *a* right aspect, *b* lower aspect, *c* anterior aspect, showing the facet for the atlas. × ½. (Type: Cope, l. c. 1887, p. 222 "?third cervical").

Fig. 29. *?Cœlophysis longicollis.* Centrum of a dorsal vertebra in lateral and lower view. × ½.

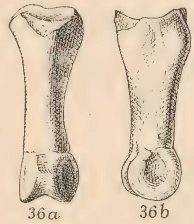
Fig. 30. *?Cœlophysis longicollis.* Centrum of a larger dorsal vertebra, with transverse section. × ½.

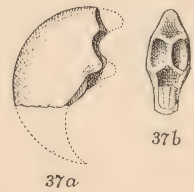
Fig. 31. *?Cœlophysis longicollis.* Transverse process of a dorsal vertebra, upper aspect, with sections. × ½.

Fig. 32. *Cœlophysis longicollis.* Centrum of middle tail vertebra; *a* right, *b* lower, *c* posterior aspect. with facets for hæmapophysis. × ½. (Type: Cope, l. c. 1887, p. 223).

Fig. 33. *Cœlophysis longicollis.* Articular extremity of scapula; *a* inner view, *b* glenoid face. × ½.

Cœlophysis belongs in the family Podokesauridæ recently established by the writer (l. c.). All the bones are hollow and have thin walls. The vertebræ are elongated; the sacrum consists of at least 3 vertebræ, probably





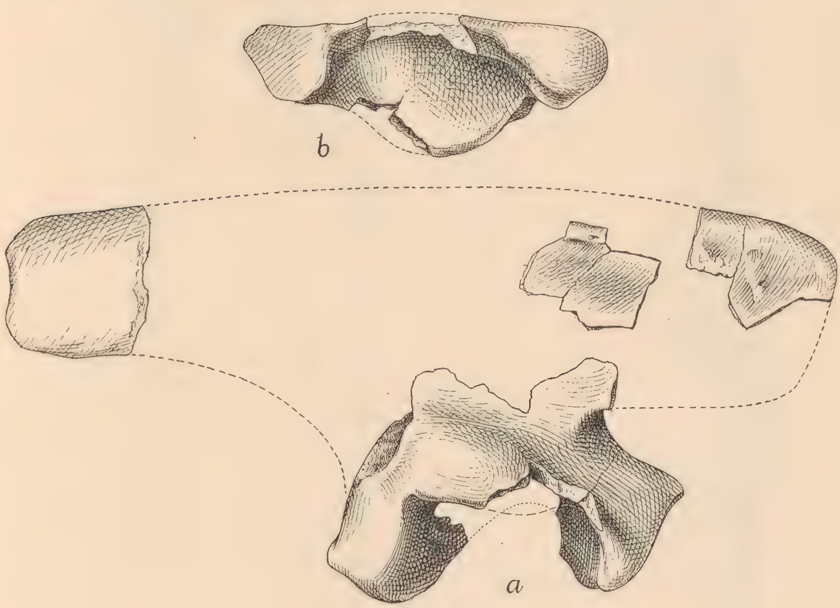


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Fig. 34. *Cœlophysis longicollis.* Distal end of a large metacarpal; *a* side view, *b* articular facet. × ½.

Fig. 35. *Cœlophysis longicollis* or *C. bauri.* Distal end of smaller (lateral?) metacarpal. × ½.

Fig. 36. *Cœlophysis longicollis.* First phalange of largest finger; *a* front, *b* side view. × ½. (Type: Cope, l. c. 1887, p. 225).

Fig. 37. *Cœlophysis longicollis.* Claw phalange of first(?) finger; *a* side view, *b* articular view. × ½. (Type: Cope, l. c. 1887, p. 225).

Fig. 38. *Cœlophysis longicollis.* Fragments of right ilium; *a* lateral aspect, *b* from below showing articular facets for ischium and pubis and big acetabular crest. × ½. (Type: Cope, l. c. 1887, p. 224. "No. 2".)

4. The ilium is of the *Ornitholestes* type and differs from that of the Triassic Pachypodosauria by the bulky lower process and the broad spina anterior. The pubis is slender and longer than the femur (different from

the Pachypodosauria). There are only fragments of the ischium at present, Cope's better specimens apparently being lost. The proximal extremity of the tibia of *Cœlophysis bauri,* if the determination is correct, differs essentially from the Pachypodosauria. From the anterior leg are only fragments of the manus, showing it to have been extremely long and slender, very much like *Ornitholestes.* A small fragment may represent part of the scapula.

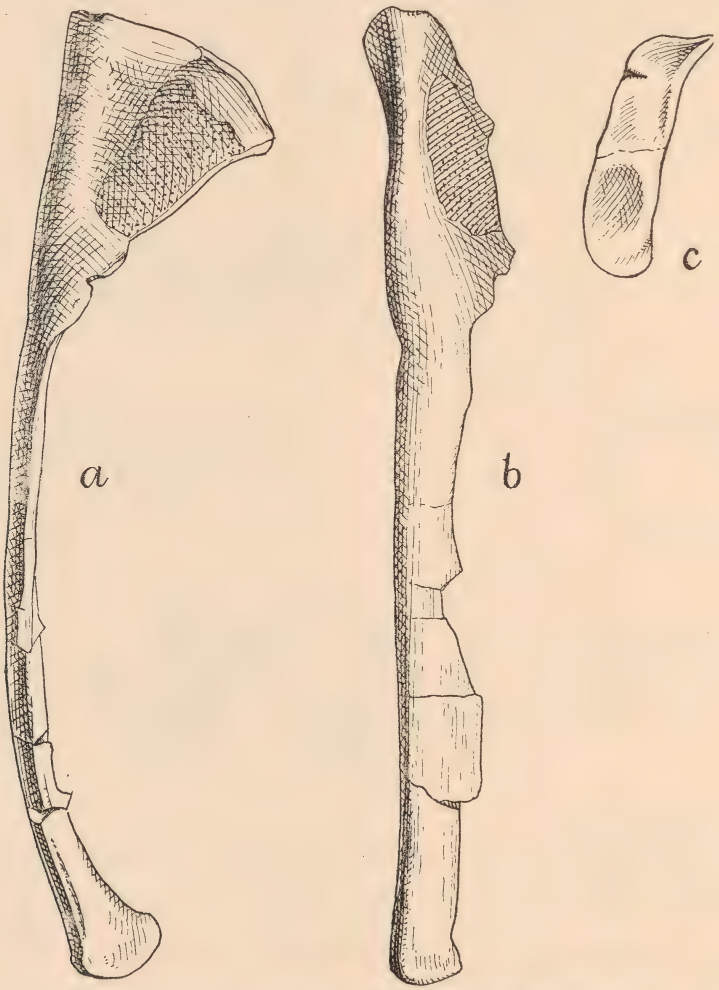


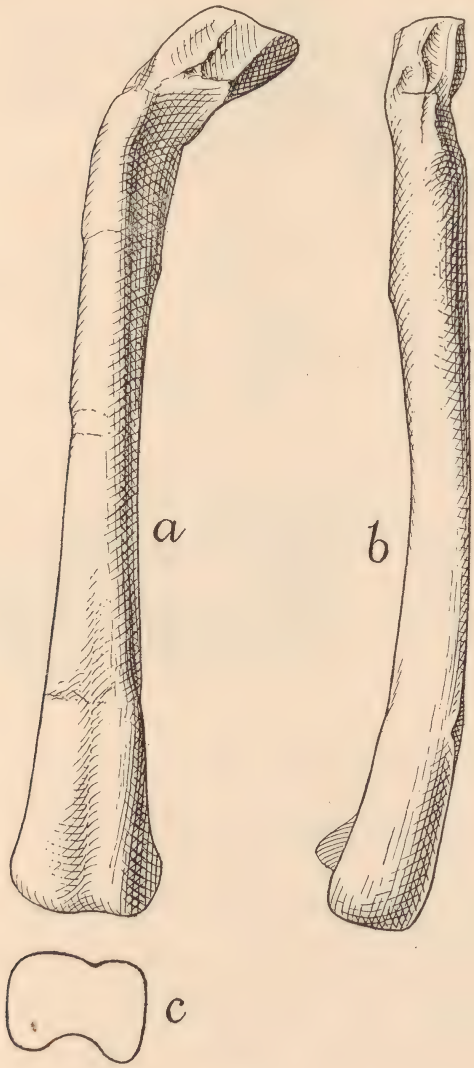
Fig. 39. *Cœlophysis longicollis.* Right pubis (articular facet fitting with the ilium, Fig. 38, therefore belonging with the same individual); *a* medial, *b* upper, *c* articular view. × ½. (Type: Cope, l. c. 1887, p. 228).

Cœlophysis longicollis is the largest: *Cœlophysis willistoni* the smallest species.[1] There may even be more than three similar species. In the sacral vertebræ of *Cœlophysis bauri* the exitus of the spinal nerves are

[1] The figures will give the best idea of these species.

visible at the sides of the anterior halves of the second and third sacral vertebra. Part of an ilium of *Cœlophysis bauri* is connected by matrix with this sacrum of *Cœlophysis bauri.* The acetabulum of the ilium of *Cœlophysis willistoni* is relatively far wider than in *Cœlophysis longicollis.* The latter species seems to vary quite a good deal in size, as shown by vertebræ and ilia.

Stratigraphical position and locality. Cope refers to these bones only as



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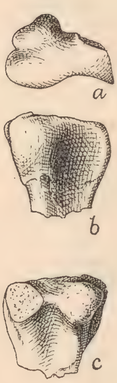

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Fig. 40. *Cœlophysis longicollis.* Right femur; *a* anterior, *b* lateral, *c* distal view. × ½. (Type: Cope, l. c. 1887, p. 225).

Fig. 41. *Cœlophysis longicollis* or *C. bauri.* Proximal extremity of right(?) tibia of *C. bauri* or of a big metatarsal of *C. longicollis:* three views. × ½. (Type: Cope, l. c. 1887, p. 226 "tibia of C. bauri").

coming from the Trias of New Mexico. Labels and letters lying with them show that they were found by the late David A. Baldwin, 1881, in Rio Arriba County, New Mexico, in the vicinity of the Chama River, western tributary of the Rio Grande del Norte, especially near Gallina and in Arroyo Seco. Most specimens were obtained near the former locality. Williston and Case have rediscovered the place (cf. their paper: The Permo-

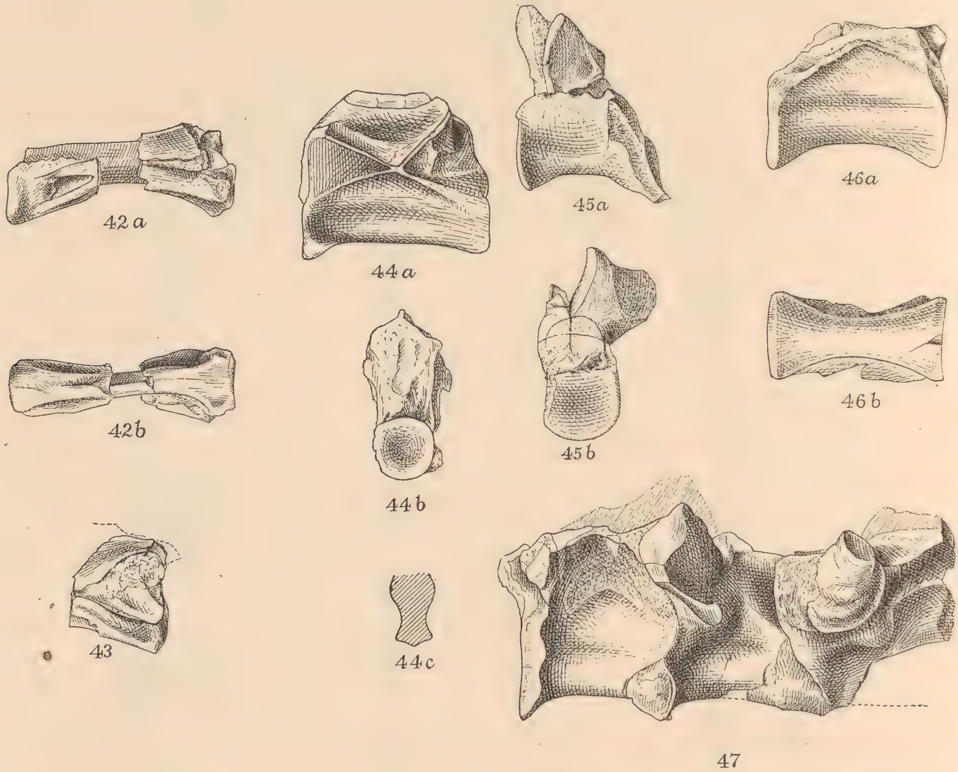


Fig. 42. *Cœlophysis bauri* Cope. Third or fourth cervical vertebra; *a* from right side, *b* from below, showing cast of big internal hole together with neural canal connecting both extremities of the injured vertebra. × ½. (Type: Cope, l. c. 1887, p. 226 "third cervical".)

Fig. 43. *Cœlophysis bauri.* Left aspect of fourth or fifth cervical vertebra. × ½.

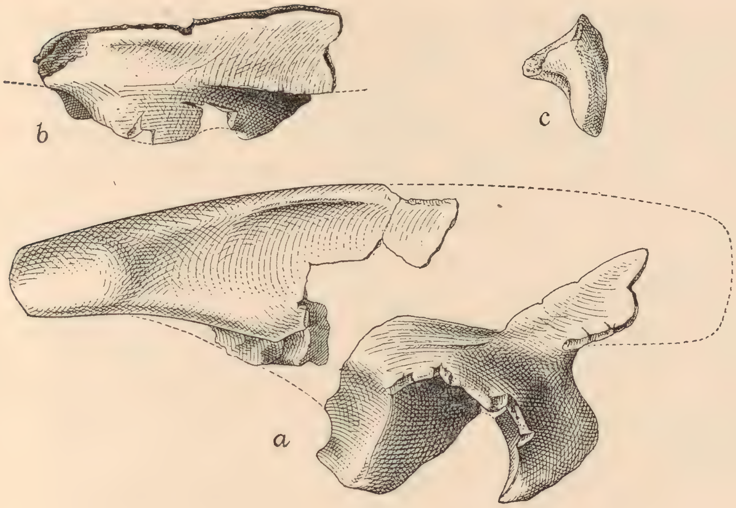
Fig. 44. *?Cœlophysis bauri.* Ninth or tenth cervical vertebra; *a* left aspect, *b* anterior aspect, *c* transverse section. × ½.

Fig. 45. *Cœlophysis bauri.* Anterior dorsal vertebra with left transverse process and left prezygapophysis; *a* left, *b* front aspect. × ½.

Fig. 46. *Cœlophysis bauri.* Dorsal vertebra, centrum, two views. × ½. (Type: Cope, l. c. 1887, p. 223 "*C. longicollis*").

Fig. 47. *Cœlophysis bauri.* Sacrum, two and one-half anterior sacrals; a fourth one was probably in existence. Left aspect. × ½.

carboniferous in northern New Mexico. Journ. of Geology, 1912, p. 3 and 11); it is at the foot of the upper Triassic rocks north of Cerro Blanco, near the settlement Gallina, and opposite the face of the Capulin Mesa bluff. Case found there various fresh-water shells and bone fragments



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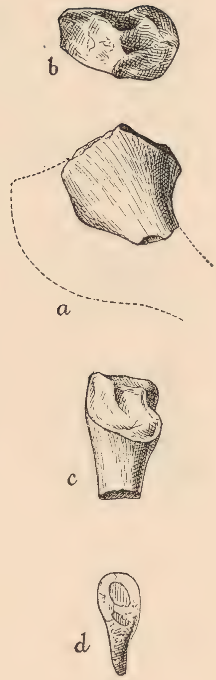

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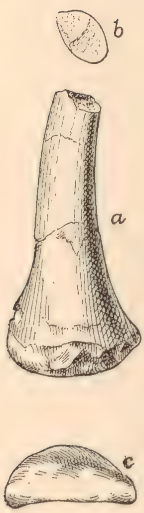

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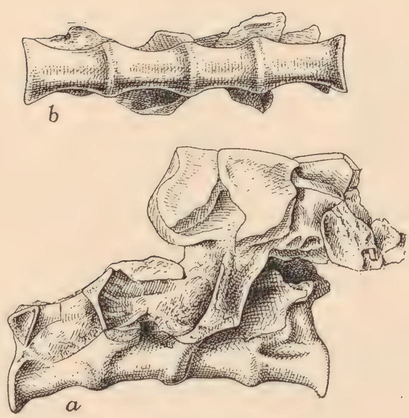

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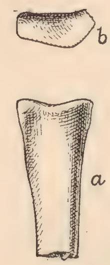

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Fig. 48. *Cœlophysis bauri.* Two pieces of right ilium with restoration in dotted line; *a* lateral view, *b* upper view of lower part, *c* posterior view of upper part showing medial crest and real breadth of posterior spine which is oblique in *a* and therefore seems narrower. × ½. (Type: Cope, l. c. 1887, p. 224 "No. 1 of *C. longicollis*").

Fig. 49. *Cœlophysis bauri.* Proximal posterior part of left ischium; *a* lateral, *b* upper, *c* posterior, *d* lower view. × ½. (Type: Cope, l. c. 1887, p. 226).

Fig. 50. *Cœlophysis bauri.* Distal part of left ischium; *a* lateral, *b* upper, *c* end view. × ½. (Type: Cope, l. c. 1887, p. 226).

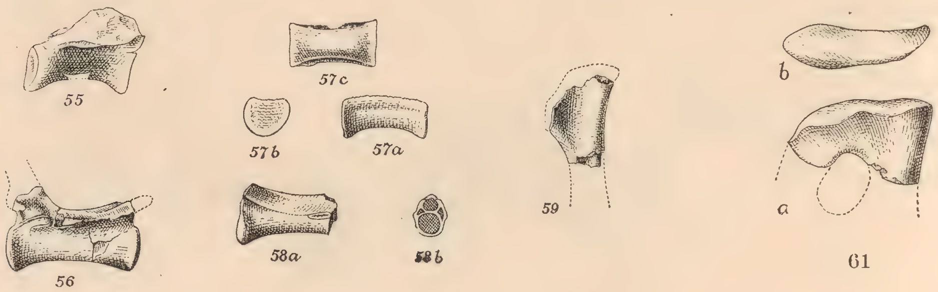
Fig. 51. *? Cœlophysis bauri.* Proximal extremity of fibula (?), two views. × ½.

Fig. 52. *Cœlophysis willistoni* Cope. Upper arch of cervical vertebra, anterior part. × ½.

Fig. 53. *Cœlophysis willistoni.* Centrum of dorsal vertebra, lateral view. × ½. (Type: Cope, l. c. 1887, p. 226 "*C. bauri*".)

Fig. 54. *Cœlophysis willistoni.* Sacrum, consisting of four vertebræ; *a* left, *b* lower view. Above the vertebræ is a pubic process of an ilium of *C. bauri.* × ½. (Type: Cope, l. c. 1887, p. 226 "*C. bauri*".)

provisionally referred by Williston to the genus *Cœlophysis*. As shown by the writer (Kurze Mitteilung über Perm, Trias und Jura in New Mexico, N. Jahrb. f. Min. etc. Beil. Bd. 32, 1911, p. 730–739) the Trias in Poleo Creek and Mesa Prieta near Gallina is divided into two parts by the "Poleo-top-sandstone." The basis of the latter is equivalent to the



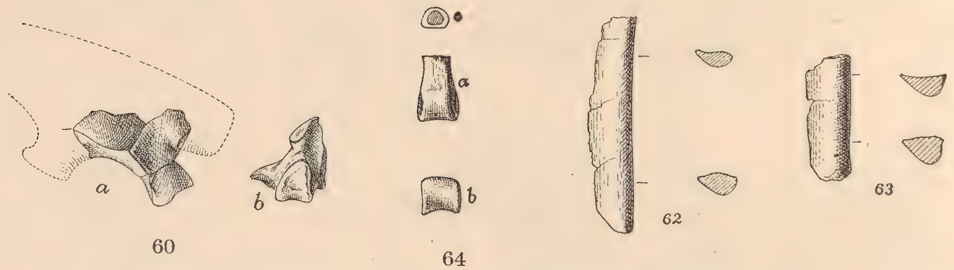


Fig. 55. *Cœlophysis willistoni.* Anterior tail vertebra, right aspect. × ½.
Fig. 56. *Cœlophysis willistoni.* Middle tail vertebra, right aspect. × ½.
Fig. 57. *?Cœlophysis willistoni.* Tail vertebra, centrum, three views. × ½. Or perhaps a dorsal of a very small specimen. (Type: Cope, l. c. 1887, p. 227, "dorsal".)
Fig. 58. *Cœlophysis willistoni* or *C. bauri.* Half of tail vertebra; *b* section showing neural canal and three cavities. × ½.
Fig. 59. *Cœlophysis willistoni.* Right humerus, anterior aspect. × ½.
Fig. 60. *Cœlophysis willistoni.* Part of right ilium; *a* lateral, *b* anterior aspect showing pubic facet and acetabular crest. × ½. (Type. Cope, l. c. 1887, p. 227).
Fig. 61. *Cœlophysis sp.* A species of *Cœlophysis* medium in size between *bauri* and *willistoni.* Head of right pubis with articular face. × ½.
Fig. 62. *Cœlophysis willistoni.* Fragment of middle part of pubis. × ½.
Fig. 63. *Cœlophysis willistoni.* Distal extremity of left ischium, lateral aspect with sections. × ½.
Fig. 64. *Cœlophysis willistoni.* Distal extremity of metatarsal, three views. × ½.

Shinarump conglomerate of Colorado and Utah, a horizon yielding Phytosaurian and Labyrinthodont bones in a very wide area in New Mexico, Arizona, Utah and Colorado, and even in Wyoming. The Triassic clays and sandstones below this horizon contain some fossil wood, but no other fossils. This lower division is 50–60 m. thick in Poleo Creek. The Poleo-top-sandstone is about 12–15 m. thick. Above it are the upper red beds with a thickness of about 70 m. The top of the Trias (above the latter) is formed by 50 m. of compact yellow sandstone, the "Prieta sandstone"; it is covered by 20 m. of gypsum, probably being the base of the Jurassic. Now the level where Case in 1911 found invertebrates and bones of *Cœlophysis* is in the Upper Triassic red beds, not less than 30 m. above the Poleo-top-sandstone, that is, about in the middle of the upper red beds. So their age must be supposed to be Upper Triassic. Baldwin's discoveries demonstrate that *Cœlophysis* occurred together with *Typothorax* and *Episcoposaurus*. But other Phytosaurian bones are of another (more red) color and so must come from another horizon. It cannot be taken as certain that the Phytosaurian remains from the base of the Poleo-top-sandstone (= Shinarump horizon) also are of Upper Triassic age (Keuper) or whether they already belong to the middle Trias. The whole Trias is called Dolores formation in southwestern Colorado, and the New Mexican Trias is the direct continuation of it.

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59.82 (67.5)

Article XVI.— DESCRIPTIONS OF THREE NEW BIRDS FROM THE BELGIAN CONGO.

By James P. Chapin.

The whole of the large collection of birds secured by the Congo Expedition of the American Museum of Natural History during the years 1909 to 1915, under the leadership of Mr. Herbert Lang, has now arrived safely at the Museum. It is composed of material gathered all across the Belgian Congo, from Boma on the west to Aba in the northeastern corner, but the greater part from the more remote territory between Stanley Falls and the Enclave of Lado, including the dense equatorial forests of the Ituri, Nepoko, and Bomokandi, and the high-grass and bush country of the Uele District to the north and northeast.

Of the relatively small number of zoölogical expeditions that have passed through and collected in these regions, none has ever before been able to make such a prolonged stay, and the varied zoölogical results of this Expedition are surely of the highest scientific interest. The ornithological collection contains in the neighborhood of six thousand skins, and represents some 600 different species, a number of them of course new to science. These it is our purpose to describe as promptly as possible in this Bulletin, before taking up the greater work of a general report on all the forms collected, with more extended notes on their distribution, habits, food, and nests.

Descriptions of the first three new forms follow:

Chætura melanopygia sp. nov.

Related to *C. stictilæma*, but much larger, with feathers of upper breast more heavily margined with blackish, and without any trace of a light rump-band.

Description of type, collector's No. 4986 Congo Exp. A. M. N. H., ♂ ad. Avakubi, Ituri District, Belgian Congo, Aug. 15, 1913.

Upper parts brownish-black (chætura-black, Ridgw.) becoming black on wings and tail, with faint violet and green reflections (green on freshly molted feathers). Ear coverts drab, bordered with fuscous-black; feathers of throat pale smoke-gray, margined with fuscous, those of upper breast similar, but heavily bordered with fuscous-black, consequently with a very pronounced "scaly" appearance; lower breast growing darker, so that the dark borders are less conspicuous, and the feathering of the belly completely fuscous-black with slight oily gloss. Under wing coverts mouse-gray with darker edges, flanks and under tail-coverts black with slight greenish gloss. Tail slightly rounded.

Iris dark brown, bill black, feet bluish, shading to dusky brown on tips of toes and claws. Sexual organs enlarged.

Length (skin) 145 mm.; wing 164; tail 49.5; bill (exposed culmen), 7.5; metatarsus 13.

Only one specimen secured, out of two or three of these swifts that were flying about over the Ituri River, in company with several examples of *Chætura cassini.* In spite of our long stay in this region, the species was not again positively recognized; but *Chætura cassini, C. stictilæma* and *C. sabinei* were all of common occurrence there.

Apaloderma minus sp. nov.

Resembling *Apaloderma narina,* but decidedly smaller, of different coloration, and with bill less swollen. The serration of the maxilla is less pronounced.

The adult male of *A. minus* is distinguished by the bluer hue of the forehead, throat, and upper breast, which show in certain lights deep violet reflections, and by the more scarlet, less crimson color of the remaining underparts. In life the naked areas on the cheeks are bright yellow, whereas in *A. narina* they are light green.

The adult female differs in the more tawny or ochraceous coloration of the breast, which is grayish in this sex of *A. narina,* although sometimes washed with light brown on the upper breast. A greenish gloss on the upper breast is more common in females of *A. narina.*

In juvenal plumage both species are entirely buff below, the feathers more or less tipped with dusky.

Type: collector's No. 4983. Congo Exp. A. M. N. H. ♂ ad. Avakubi, Ituri District, Belgian Congo, August 13, 1913.

Description of Adult Male (type).— Throat, upper breast, lores and forehead glossy wall-green, in certain lights with violet reflections; upper tail-coverts much the same, but nape and back brilliant peacock-green. Lower breast, sides, belly, and under tail-coverts bright scarlet-red; feathering of legs dusky, with faint green gloss and slightly bordered with whitish. Primaries fuscous-black, the outer ones margined with white and the inner ones white at the base. Alula and primary-coverts blackish; lesser wing-coverts blackish, broadly margined with green; middle coverts with less green and vermiculated with white. Greater coverts and secondaries blackish vermiculated with white, the former narrowly edged with green, the secondaries only very faintly. Three middle pairs of rectrices blackish, slightly glossed with violet-blue and margined with green; outer three pairs white, with bases black faintly glossed with blue, this blackish color extending out furthest on inner webs, and finally breaking up into small dusky spots.

Iris red-brown; distal portion of bill light greenish gray, base of bill and two naked patches beneath eye light cadmium-yellow, naked skin above eye lemon-yellow; bare skin of foreneck (covered in life by plumage) light blue; feet pale pink.

Length (skin) 254 mm.; length of bill (culmen from base) 18 mm.; height of bill at nostril 9.5 mm.; greatest width of maxilla, near gape, 16 mm.; wing (measured with dividers) 113 mm.; tail 146 mm.

In some of the other male specimens the green borders on the secondaries are lacking, and the exact intensity of the white vermiculation is of course variable. The measurements of a series of 11 adult males are: bill, 17–18.5 mm.; wing, 108–115.5; tail, 136.5–151. This is smaller than any *Apaloderma* heretofore described.

Adult Female. Crown, back, and rump brilliant peacock-green, upper tail-coverts viridian. Lores, forehead, and ear-coverts more brownish; throat and upper breast snuff-brown, sometimes with glossy green at sides of neck or a few narrow green borders on the chest. Lower breast cinnamon, sometimes finely barred with dusky; belly somewhat lighter and rosier than that of male; feathering of legs dusky. Tail similar to that of male; but the vermiculation on the wing-coverts and secondaries is very much finer, and light ochraceous-buff, not white.

Iris red-brown; naked cheek-patches lemon-yellow, base of bill slightly deeper yellow; culmen dusky, bill light green below; feet flesh-color, claws gray.

Measurements of three adult females: bill (culmen from base), 17–17.5 mm.; wing 104.5–113 mm.; tail, 140–149 mm.

An *immature male* has the green of the upper breast broken by irregular bars of cinnamon. The lower breast is cinnamon mixed with rose, and barred at the sides with green, and shades to light scarlet-red on belly and under tail coverts. The greater wing-coverts and three inner secondaries bear each a large spot of light ochraceous buff, extending across the whole width of the innermost secondary, and most of the secondaries are vermiculated or speckled on their outer webs with buff. Just behind the eye there is a small spot of white, and the lower edge of the ear-coverts is marked by a buff line.

Iris dark brown; maxilla dusky, but its base greenish-yellow like the naked cheek-patches, mandible light yellowish-green, with light-gray tip; feet pinkish. Bill, 18.5 mm.; wing, 108; tail, 139.

A *nestling* (♂), with tail only 25 mm. long, is of a yellower green above (calliste green); lores, forehead and entire underparts cinnamon-buff, the downy feathers slightly tipped with dusky except on abdomen. The wing-coverts and inner secondaries bear large spots of buff. Iris brownish-gray; bill very light bluish-gray, its base and corners of mouth greenish-yellow; feet pale flesh-color, claws gray.

The spots on the inner secondaries, in the first plumage, appear to be much larger in the case of *A. minus* than with *A. narina*, for an immature female specimen of the latter shows only rounded spots on the outer webs not exceeding 5.5 mm. in diameter, while the additional buffy speckling is practically absent.

This trogon was found by us in the Ituri forest, from the Nepoko River south to Avakubi and westward to Banalia, but its range is certainly wider than this. It is a species perfectly distinct from *Apaloderma narina*, but both occur in the same forests, though the latter was also to be heard at times in areas of tall second-growth, whereas *A. minus* seemed never to leave the primitive uncut forest, and was extremely shy and difficult to observe. These two trogons may easily be recognized by their voices, the common note of *A. narina* being a double, dove-like "cu-coo," which is repeated slowly for several seconds, starting faintly but increasing in strength, and accompanied by a slight wagging of the tail. That of *A. minus* is a series of longer, more mournful sounds that might be represented by the word "kwaw." These calls are given by the males.

As compared with the measurements given in Prof. Reichenow's "Vögel Afrikas" and the British Museum Catalogue, our specimens of *Apaloderma narina* from the Ituri District seem rather small, and may belong to the race *æquatoriale* of Dr. Sharpe.

A series of 12 adult males measures: bill (culmen from base) 18.5–21 mm.; wing 117.5–128; tail 146.5–166. The green borders of the secondaries are never very well marked, and sometimes virtually absent.

Seven females from the same region measure: Bill, 18.5–21; Wing 117.5–129; Tail, 149–169.

One male collected in the Uele District, in a small forest tract between Faradje and Aba, is strikingly larger; wing, 134; tail 194. This example is probably referable to *A. n. narina.*

Ceriocleptes gen. nov. (Indicatoridæ).

Resembling *Indicator* in its bill and general form, save for the tail, which is composed of 12 quills, the two middle pairs of nearly equal length, somewhat pointed and curved strongly outwards, the next pair considerably shorter, but also pointed and slightly curved; while the fourth, fifth and sixth are straight, greatly narrowed, and stiffened, becoming successively shorter, so that the outermost pair is not half so long as the median. The tail-coverts are unusually long, those below as long as the longest rectrices, and projecting in the fork of the tail.

Ceriocleptes xenurus sp. nov.

Description of type, collector's No. 5628, Congo Exp. A. M. N. H. ♂ ad., Avakubi, Ituri District, Belgian Congo. Apr. 17, 1914.

Feathers of forehead, crown, back, and rump blackish-brown, bordered or washed with yellowish-citrine, those of nape and upper back whitish at the base. Sides of head lighter, shading gradually to olive-buff on throat, breast, and sides; middle of abdomen still lighter, ivory-yellow. Upper wing-coverts and secondaries fuscous-black (freshly molted feathers blacker) narrowly edged with olive-ocher. Primaries similar, but yellowish border almost entirely lacking; both primaries and secondaries fading to pale olive-buff on their inner edges. Under wing-coverts colored like the breast, but with faint dusky shaft-streaks. Feathering of flanks ivory-yellow, with strong blackish median lines. Two middle pairs of rectrices dull blackish; 3rd pair whitish, with a small blackish spot on the outer edge close to the tip, and a larger concealed black spot on the inner web towards the base; the 3 remaining pairs of rectrices white. The long median pair of under tail-coverts blackish, the next pair similar, but margined with whitish, the remainder ivory-yellow with faint shaft-streaks of dark brown. Upper tail-coverts fuscous-black, bordered with amber-yellow.[1]

The bill, nostril, and feet resemble those of *Indicator indicator*, but the bill is somewhat stouter, while the wings and tail are shorter. The 9th (outer) primary is intermediate in length between the 6th and 5th; the 7th and 8th are longest.

Iris bright brown, naked edges of eyelids grayish-brown; bill dusky-brown; feet dull grayish-green.

Length (skin), 160 mm.; wing, 93.5; tail 56; bill (culmen from base), 13.5; metatarsus, 14.

Fig. 1. Tail of *Cerioclevtes xenurus*, from below. Nat. size.

This unique specimen was shot by the describer from a tall tree in the forest, where it was accompanied by one other of its kind. The sexual organs were somewhat enlarged; the stomach filled with beeswax, mixed with small pieces of insects. Apparently this species is not in the habit of leading men to beehives.

[1] Colors named according to Ridgway's 'Color Standards and Nomenclature.'

59.82

Article XVII.— THREE NEW GENERA OF BIRDS.

By W. DeWitt Miller.

Stringonax gen. nov.

Type *Bubo blakistoni* Seebohm.

Related to *Ketupa* but differing in the form of the bill which has a broad, shallow groove running forwards from each nostril, the sides of the maxilla below this depression being swollen; the tarsus densely clothed to base of toes with short, soft, downy or fur-like feathers, instead of being conspicuously bare for a greater or less distance above the toes; the spicules on under side of toes less pronounced.

The type of this genus and its near ally *S. doerriesi* Seebohm, though heretofore referred to *Bubo* (even by Hartert, as late as 1913, in 'Der Vögel der palaärktischen Fauna') bear no close relationship to that genus but on the contrary, as noted by Ridgway (Birds of N. and M. Amer., Pt. VI, p. 737) are very distinct generically. They are undoubtedly most closely related to the Fish Owls, *Ketupa,* of which they are doubtless the northern representatives.

In addition to the diagnostic characters cited above, the species of *Stringonax* differ from those of *Ketupa* in superior size, being the largest of all Owls though considerably surpassed by *Huhua nipalensis* and *Scotopelia peli,* at least, in the size of the bill, feet and claws.

The affinity with the Oriental Fish Owls, *Ketupa,* and the Ethiopian Fish Owls, *Scotopelia,* is shown in the compressed claws, with sharp, knife-like posterior edge, the spiculate soles, the fur-like character of the tarsal plumage and the unfrayed outer edge of the outermost primary. In coloration there is a striking resemblance to *Ketupa. Ketupa flavipes* (which I have not seen), the northeastern representative of its genus, shows a significant approach to *Stringonax* in larger size and much more extensively feathered tarsus.

From the genera *Bubo, Huhua* and *Pseudoptynx,* which are closely related *inter se, Stringonax* differs in form of bill, character of tarsal plumage, spiculate toes, knife-like claws (which are relatively shorter and less attenuated), unfrayed edge of outer primary (approached by *Pseudoptynx*) and coloration. It further differs from *Bubo* in the perfectly bare toes and shorter outer primary, from *Huhua* in relatively smaller bill, feet and claws, and from *Pseudoptynx* in form of tail. From *Scotopelia* it may at once be distinguished by its feathered tarsus and the presence of conspicuous ear-tufts. Furthermore, the nostril differs in form and position, the tail is relatively much shorter, and the toe spicules are blunter.

Of the genus *Bubo* I have examined in this connection, *B. virginianus* and allied American forms, *B. bubo, B. bengalensis, B. coromandus, B. lacteus, B. verreauxi* and *B. maculosus.* "*Bubo*" *lettii* of the 'Hand-List,' is, according to Sharpe (B. B. O. C., X, lv) referable to *Scops* (=*Otus*).

In the two specimens of *Pseudoptynx philippinensis* examined the central pair of tail-feathers is considerably shorter than the outer pair instead of being decidedly longer as in other Bubonidæ. It has been stated that in the Barn Owls (Tytonidæ) alone, among Owls, are the middle rectrices shorter than the outer (Clark, Proc. U. S. Nat. Mus., XVII, 1895, 565).

Uropsalis gen. nov.

Type *Hydropsalis lyra* Bp.

Related to *Hydropsalis* Wagl. and *Macropsalis* Scl.; differing from the former in having the central pair of rectrices shorter than instead of much longer than the next three pairs; from the latter in the much smaller wing, the outer three primaries not specially enlarged, the tenth shorter than instead of longer than the ninth, three instead of only two primaries emarginate on the inner web; and in the broadly rounded instead of tapering and obtusely pointed tips of the first four pairs of rectrices; the latter much less strongly graduated, the fourth pair exceeding the third by less than one-half the length of the first pair instead of by more than the length of the first.

In addition to the type species, *Hydropsalis segmentata* Cass. is also referable to this genus. This species agrees with *U. lyra* in the form of the wing and differs from *Macropsalis* in the form of the tail even more than does *U. lyra,* the tail (omitting the outer pair of rectrices) being merely emarginate instead of strongly forked.

While Dr. Sclater referred these two species to his subgenus *Macropsalis,* and this course has been followed ever since, they differ so conspicuously from the type and (as here restricted) only species of that genus, *M. creagra,* in the form of the wing and in the shape and graduation of the rectrices, that there is no question of their generic distinctness. In the form of the wing they agree with the shorter-tailed species of *Hydropsalis* (subgenus *Diplopsalis*), the longer-tailed species of that genus slightly approaching *Macropsalis* in this respect.

In *Uropsalis lyra* the longest primary (the ninth) reaches $1\frac{3}{16}$ inches beyond the tip of the seventh, while in *Macropsalis creagra* (a bird of about equal size) the distance from the latter point to the tip of the longest (tenth) quill is three inches. The unusual development of the outer three primaries in *Macropsalis* is to a large degree a sexual character, highly developed in the male only. In the female the eighth, and particularly the ninth and tenth primaries are much less enlarged, the wing in consequence being much shorter than in the male. In *Uropsalis* the wing is of the same length in both sexes.

A further difference is seen in the long outer tail-feathers. In *Macropsalis* and *Hydropsalis* the shafts of these feathers are stout and strong, tapering very gradually to the tip. In *Uropsalis* the shaft, while not conspicuously more slender at the base, is rapidly reduced, and throughout the greater part of its length is very slender, only about half as thick as in *Macropsalis;* in the last four inches, however, it widens out and becomes twice as wide as at the corresponding point in *Macropsalis.* This is shown excellently in *U. lyra,* much less so in the single male specimen of *U. segmentata* examined, the outer rectrices of which, however, are not fully developed, at least as to length.

In *Macropsalis* and *Hydropsalis* the rectrices are conspicuously marked with white on the inner web. This is not the case in either of the species of *Uropsalis.*

Chryserpes gen. nov.

Type *Picus striatus* Müll.

Similar in general structure to *Centurus* [1] but with straighter bill which, seen from above, is relatively narrower basally, the terminal half thicker and with more nearly parallel sides as far as the wedge-shaped tip, the culmen sharply ridged, culminal "shelves" broader and flatter, supranasal ridge better developed, running out distinctly beyond middle of culmen, terminal portion of maxillary tomium distinctly (though not sharply) beveled, the tip deeper (more chisel-like); feathers of crown and nape shorter, those of nape smaller, stiffer and more compact (not lengthened into a short crest as in *Centurus*), the barbs shorter, coarser and closer; upper tail-coverts much less than one-third the length of the tail instead of much more than one-third; middle rectrices narrower and less abruptly acuminate terminally. Tuft of oil-gland more nearly vestigial. Coloration wholly different from the very uniform style of *Centurus.*

The fourth toe is equal to the third instead of shorter as in most of the species of *Centurus. C. uropygialis* and *C. hypopolius* however agree with *Chryserpes* in this respect. In the short, rounded wing and relatively long outer primary *Chryserpes* is equalled only by *C. radiolatus.*

The striking color differences between the two genera are set forth in the accompanying table.

The peculiar Haitian Woodpecker for which this genus is proposed passed as *Picus striatus* until 1846 when Gray referred it to *Centurus,* where it was allowed to remain until Hargitt in 1890 (British Museum Catalogue) transferred it to *Chloronerpes.* Judging by the key given in the 'Catalogue,' Hargitt relied on the supposed shorter wing-tip to distinguish this species from *Centurus,* but in this respect it agrees closely with *C. radiolatus* of Jamaica.

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[1] All the species of *Centurus* with the exception of *C. nyeanus* and *C. hypopolius* have been examined.

	Chryserpes.	*Centurus.*
Nasal tufts	Ash-gray	Red or yellow (obsolete in *C. uropygialis*)
Crown of female	With a rectangular black patch	Without black (occiput black in *C. superciliaris*)
Sides of neck	With a tuft of soft, silky, buffy-white feathers, above which is a large black spot	Uniform gray or ashy-brown like chest
Mantle	Broadly barred with black and yellow	Barred with black and white
Upper tail-coverts	Concealed portion blackish, exposed tips broadly bright red	White, with or without black bars; concealed portion barred with white or wholly white
Tertials	Inner webs uniform clay-color; outer webs black, with few, wide, rounded-off buff-yellow bars which tend to become confluent on outer margin of feathers	Regularly barred on both webs with black and white, the white bars more numerous, narrower and straighter, not tending to become confluent on margin
Outer Webs of primaries	Regularly spotted with yellow, like the secondaries	Unlike the secondaries, scarcely marked or with a subbasal white blotch
Rectrices	Wholly unbarred	Always more or less barred with white
Abdomen	Greenish yellow of mid-belly ill-defined, blending with greenish of flanks	Mid-belly with a conspicuously defined stain of red or yellow
Flanks and crissum	Greenish, unbarred	White or whitish, distinctly barred with blackish
Under wing-coverts	Greenish or cream-color with almost obsolete dusky bars	White, distinctly barred with black
Lower mandible	Light shade lighter and more extensive	Light shade more obscure and restricted or wholly wanting
Iris	Yellow	Red or brown, rarely orange (11 species recorded)

Besides differing even more strikingly in pattern of coloration from *Chloronerpes* than from *Centurus,* it differs also in shorter wings, more graduated tail, longer, stronger bill, which seen from above is narrower basally and thicker terminally, the maxillary tomium less sharply beveled towards tip, the gonys less concave (and longer than in most species of *Chloronerpes*), the lower mandible less attenuated terminally.

There is little doubt that as considered by Ridgway (*cf.* Bds. of N. & M. Amer., Pt. VI, p. 48), *Chryserpes* finds its nearest relation in *Centurus,* which it represents in San Domingo and Haiti; Jamaica and Cuba each being occupied by a species of *Centurus,* and Porto Rico by an isolated form now referred to *Melanerpes.*

In the recent treatment of the *Melanerpes* group by Mr. Ridgway, it is considered as separable into seven genera, the addition of *Chryserpes* making eight. In this group style of coloration is evident'y a very reliable index of affinities. Thus a red or yellow stain on the abdomen runs through all the genera except *Balanosphyra.* In the 18 or 20 species of *Centurus* the general pattern is remarkably uniform, and *Tripsurus* while agreeing in most respects with *Centurus* has several peculiarities of its own. *Asyndesmus, Leuconerpes, Balanosphyra, Linneopicus, Chryserpes* and (to a less extent) *Melanerpes* [1] are all strongly characterized by coloration, in each case associated with diagnostic structural characters.

Judged both by color and form *Chryserpes* is less closely allied to *Centurus* than is the latter to *Tripsurus,* and while the desirability of recognizing *Tripsurus* is open to question, *Chryserpes* differs from both of these genera in so many points that they share in common that it is entitled to generic rank, even should *Tripsurus* be merged in *Centurus.*

From the other genera of the *Melanerpes* group, *Chryserpes* is distinguished by many peculiarities of coloration. In addition it differs from *Asyndesmus* and *Leuconerpes* in the form of the bill, wing and tail; from *Balanosphyra* and *Melanerpes* in bill and wing, and from *Linneopicus* in bill and tail.

There is little doubt that *Chryserpes striatus* consists of two or three races differing chiefly if not wholly in size. A series of 22 adults, 7 from Haiti (Le Coup and Jacmel) and 15 from San Domingo (chiefly the north and northeast coast) shows that the former average decidedly greater in length of wing and tail, the bill being relatively smaller. Within the series from San Domingo there is much variation in size as the figures show and this is

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[1] In view of the discrepancies in coloration and structure between *Melanerpes erythrocephalus* and *M. portoricensis* the association of these two species does not seem a happy one, especially when the rather fine distinctions between the other genera of the group and the anomalous geographical distribution of the genus as thus constituted are considered.

apparently largely geographical. Without further specimens and more exact knowledge of the localities it seems inadvisable to subdivide the species. Extreme and average measurements of the series are as follows:

2 males from Haiti: Wing 127–131 (129.), tail 95–97.5 (96.3), bill 32.4.

9 males from San Domingo: Wing 104.5–125 (115.2), tail 72–87.5 (81), bill 31.3–34.8 (32.9).

5 females from Haiti: Wing 115.7–122 (118.8), tail 86–90.5 (88.5), bill 26.5–31.9. (28.5).

6 females from San Domingo; Wing 103–118 (110.6), tail 73–87.8 (78.4), bill 26.2–29 (27.4).

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Article XVIII.— NOTES ON AMERICAN DEER OF THE GENUS *MAZAMA*.

By J. A. Allen.

CONTENTS.

During recent years the collection of South American deer of the genus *Mazama* in the American Museum of Natural History has been increased by important accessions from many and widely separated localities, the number of specimens referable to this genus now numbering about 65. They represent localities in Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Trinidad, Guiana, Ecuador, Matto Grosso, and Paraguay. In identifying this material it was necessary to make a careful study of the group as a whole, the results of which investigation are recorded in the present paper, which incidentally includes descriptions of a number of new forms. This material is of course wholly inadequate for a satisfactory revision of the group, but is sufficient to indicate the existence of a much larger number of forms than has hitherto been recognized.

I am indebted to Mr. E. W. Nelson, of the Biological Survey, for the loan of skulls of the Mexican species, and to Mr. W. H. Osgood, of the Field Museum of Natural History for a skull of his Venezuelan species, for examination in the present connection.

Distribution.

The distribution of the genus *Mazama* includes, as is well known, nearly all of tropical and subtropical America, from the State of Vera Cruz in Mexico to Paraguay, the altitudinal range extending from sea-level to 16,000 feet. The species differ greatly in size, the largest being nearly twice the weight and bulk of the smallest, the extremes being the large red brockets of the Guianas and the small red brockets of Venezuela and Ecuador. On the basis of coloration the brockets form two groups, known respectively as red brockets and brown brockets. The forms of the red group vary in color from dark chestnut red to yellowish red, with the mid-dorsal region, head, and neck ranging from black or blackish to dark brown. The members of the brown brocket group vary from drab brown in Paraguay and southern Brazil to yellowish gray brown in Guiana, Venezuela, and northern Colombia. The little *Mazama pandora* of Yucatan is the only member of the brown group known from north of the Isthmus of Panama, and none appear to have been recorded from the Andean region north of Peru. On the other hand, the red brockets appear to be quite generally distributed from tropical Mexico south to Paraguay and Bolivia.

Nomenclature.

During the early part of the nineteenth century all the brockets then known to systematists were referred to two species, a red one and a brown one, the former known as *Cervus rufus*, the latter as either *Cervus simplicicornis* or *Cervus nemorivagus*, each being assigned a very wide range. These names, as later applied, became 'blanket' names for, respectively, the red and the brown brocket groups.

The existence in Mexico, Brazil, and the Guianas of small deer with antlers reduced to simple, short spikes, became known in a general way in the eighteenth century, through the writings of travellers and sojourners in these countries, and from occasional specimens that had reached Europe, but the information given by these early authors was too vague and too incomplete to afford a proper basis for nomenclature, and most of the systematic names based on these early accounts by compilers prove to be indeterminable. Azara, in his 'Quadrupeds du Paraguay,' published in 1801, was the first author to whom we can turn for any intelligent descriptions of these small deer; he having described in great detail and with accuracy the two species which inhabit Paraguay, under the names, respectively, *Gouazoupita* and *Gouazoubira*. His attempt to identify with his species the corresponding animals of Mexico, Guiana, and Brazil mentioned by previous authors does not in the least detract from the value and usefulness of his excellent descriptions of the Paraguay animals from actual specimens. These names fortunately became the *sole basis* of systematic names proposed by Illiger, in a paper [1] read before the Berlin Academy of Sciences early in the year 1811, but which was not published till 1815. In this paper Azara's "Gouazoupita" was named *Cervus rufus* and his "Gouazoubira," *Cervus simplicicornis,* the first being the red and the other the brown brocket of Paraguay, which country is of course the type locality of both species. Thus Illiger's names, dating from 1815 and based on Azara's descriptions, form the point of departure in the consideration of the systematic names of the species of the modern genus *Mazama.*

In 1817, Frederic Cuvier (Dict. des Sci. Nat., VII, 1817, p. 485) gave names also to two species of *Mazama,* a red one and a brown one. The red one was described under the name *Cervus rufus* and was based primarily on specimens in the Paris Natural History Museum, from Cayenne [2] with which he identified the Gouazoupita of Azara. Although the Cayenne red brocket proves to be specifically different from the red brocket of Paraguay, the name *Cervus rufus* F. Cuvier is preoccupied by *Cervus rufus* Illiger and cannot be used for the Cayenne form. Cuvier's brown brocket, also from Cayenne, he named *Cervus nemorivagus,*[3] and he identified with it Azara's Gouazoubira. As the names *Cervus simplicicornis* Illiger and *Cervus nemorivagus* F. Cuvier were given to quite different species both names are available. Illiger's names appear to have been overlooked by most writers during the nineteenth century, who used F. Cuvier's names in place of them, or when both were known, *Cervus nemorivagus* was treated as a synonym of *Cervus simplicicornis.*

The earliest name requiring consideration is *Moschus americanus* Erxleben (Syst. Reg. Anim., 1777, p. 324), which until recently has been regarded as unidentifiable, but of late attempts have been made to revive it for one of the brockets of the Guianas.[4] Its status is discussed at length later in this paper (see below, pp. 533–536).

The next names in order of date to be considered are those of Kerr, published in 1792 in his 'Animal Kingdom' (Nos. 662–671), who gave provisional names to 10 "uncertain species" of Mexican and South American deer. These names were based on Hernandes, Marcgrave, Barrere, De la Borde, and Buffon. The original accounts on which they rest prove to be for the most part brief references to deer, some of which it is evident relate to

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[1] Ueberblick der Säugethiere nach iherer Vertheilung über die Welttheile. Abhandl. d. Berlin Akad., 1804–11 (1815), pp. 39–160. *Cervus rufus* and *C. simplicicornis*, pp. 108 and 117. Read before the Academy February 28, 1811, but not published till 1815.

[2] According to Sir Victor Brooke (Proc. Zool. Soc. London, 1878, p. 925) the types are Nos. 535 (female) and 532 (young), from "Surinam."

[3] According to Brooke (*l. c.*) the types are, "stuffed head of ♂ and skull of same (Cat. 2223), Paris, in Mus. d'Hist. Nat. and Mus. d'Anat. Comp."

[4] *Cf.* Osgood, Field Mus. Nat. Hist., Zoöl., X, No. 5, p. 43, footnote, Jan. 10, 1912; Thomas, Ann. and Mag. Nat. Hist. (8), XI, p. 581, footnote, June, 1913.

brockets, but without recognizable characterization of the species. His *Cervus temama,* however, has the same basis as Rafinesque's *Mazama tema* (1817), which is antedated twenty-five years by *Mazama temama* (Kerr.)[1] Some of the other citations obviously relate to red brockets and other deer of Guiana and Brazil. Thus his *Cervus cuguapara* has the same basis as *Cervus bezoartica* Linné, namely, the *Cuguacu-apara* of Marcgrave. His *Cervus caguete* was based on the *Cuguacu-ete* of Marcgrave, a red brocket from the Pernambuco district of Brazil.

Another name, dating from 1792, is *Cervus delicatulus* Shaw (Museum Leverianum, p. 149, pl. 36), based on a small spotted fawn, source of origin not stated. The specimen figured came later into the possession of G. Cuvier (*cf.* Rech. Ossem. foss., 2d ed., IV, 1823, p. 55). From the association of Cuvier's comment thereon in the text, it was evidently a young red brocket in spotted coat, presumably from Surinam.

Cervus mangivorus Schrank (Ann. Wetteraus. Gessells. gesam. Naturk., IV, 1819 (= Neue Ann. etc., I, 1819), p. 327), based on a specimen obtained in Brazil by the Spix Expedition, is unidentifiable. It was referred by Gray (Cat. Ungul. Furcip. Brit. Mus., 1852, p. 237) to *Cervus nemorivagus,* but it seems more likely referable to *Odocoileus gymnotis* Wiegmann.

Cervus humboldtii Wiegmann (Isis, 1833, p. 954, footnote 2); Abbild. u. Beschreib. merkw. Säugeth., Lief. 2, pp. 69 and 80, footnotes), was based on a deer casually mentioned by Humboldt in the narrative of his explorations in Venezuela as *Matakana.* Although obviously unidentifiable, it has been given the rank of a "selbständige Art," under the name *Subulo humboldtii,* by Fitzinger.[2]

Cervus nanus Lund (Blik paa Brasiliens Dyreverden för sidste Jordomvæltning, 1837–1845, *passim*) is included in several of his comparative lists of species (living and fossil) as "*Cervus nanus* m.," but I have been unable to find that he has given a description of it, nor can I find any description by him cited by later authors, although the name has repeatedly received mention.[3]

Cervus spinosus Gay and Gervais (Ann. des Sci. Nat. (3), 1846, p. 84, in text) is based on a pair of antlers from Cayenne, which have been considered as those of a brocket, but the name is of course not identifiable.

Coassus auritus Gray (Proc. Zool. Soc. London, 1850, p. 242, pl. xxvi, animal, pl. xxvii, fig. 6, front view of head) was based on a red brocket in the Gardens of the Zoological Society of London, from an unknown locality.

[1] *Cf.* Allen, Bull. Amer. Mus. Nat. Hist., VII, p. 191, June 20, 1895.

[2] Sitz. d. k. Akad. d. Wissens. Wien, math.-naturw. Cl., LXXIX, 1879, p. 20.

[3] *Cf., e. g.,* Burmeister, Thiere Brasiliens, I, 1854, p. 318; also Lesson, Wagner, Lydekker, etc.

Gray states later (Cat. Rumin. Mamm. Brit. Mus., 1872, p. 92, under *Coassus superciliaris*) that the type seems not to have been preserved. Brooke says (Proc. Zool. Soc. London, 1878, p. 926): "The type of *Coassus auritus* Gray, not having been preserved, I have omitted the name from my list, as without the type it will be impossible to decide with certainty upon what species Dr. Gray's name was conferred." Yet Fitzinger in 1897 (*l. c.*, p. 20) not only included the species but referred to it as "Nicht nur im zoologischen Garten zu London, sondern auch in Lord Derby's Menagerie zu Knowsley befand sich ein lebendes Weibchen dieser Art."

Coassus whitelyi Gray (Ann. and Mag. Nat. Hist. (4), XII, 1873, p. 163; Hand-list Edentate, Thick-skinned and Ruminant Mamm. Brit. Mus., 1873, p. 162, pl. xxxii, fig. 2) was based on a young skull from Conipata, Peru. Referred by Lydekker (Deer of All Lands, 1898, p. 305) to *Cervus* (*Subulo*) *tschudii* Wagner (probably on geographical grounds).

Nanelaphus namby Fitzinger (Sitz. d. k. Akad. Wissens. Wien, math.-naturw. Cl., LXXIX, 1879, p. 32), was based on two specimens collected by Natterer in Matto Grosso, Brazil, one at the Fazenda Caiçara, near Jaurú, and the other at Villa Maria, both young animals, the Caiçara specimen retaining the milk dentition.[1] Doubtless referable to *Mazama simplicicornis*. Available for the Matto Grosso form, should it prove separable from the (typical) Paraguay form.

General Considerations.

Coloration. As already noted (*antea*, p. 522), the species of *Mazama* may be separated, in a general way, into two groups on the basis of coloration, although the forms referable to each group vary much *inter se*. In the red group the general color varies from yellowish rufous to dark chestnut rufous, and in one form to dark blackish brown with only a slight rufous suffusion. The dark color along the midline of the shoulders and on the back of the neck and head varies from dull brownish to strong black, in correlation with the intensity of the general coloration. The legs vary in color from pale or dull rufous to quite intense black. The dull band of brownish (usually broken in the middle) behind the white chin varies from obsolescence to strong rufous brown. The underparts (except for certain sharply defined white areas, as on the buttocks, inside of the thighs, and inguinal region) may be uniform in tone with the flanks, or much lighter. There is considerable seasonal variation, due to wear and fading, usually easily recognizable

[1] *Cf.*, Pelzeln, Sitz. d. k. Akad. Wissens. Wien, math.-naturw. Cl., XXXIII, 1883, Beiheft, p. 85).

as such. The ears, in fresh coat, are thickly covered with very short hairs; later they are usually partly or wholly naked, as is the case with most other Central and South American deer. Individual differentiation, as such, is not usually strongly shown, most of the color variation being traceable to wear and exposure, although a tendency to melanism seems apparent in some of the normally dark forms.

In the brown group the coloration varies in different species from yellowish gray brown to drab brown, the southern forms being darker and less fulvous than the northern ones. In addition to the general more or less fulvous brown of the upperparts in the brown brockets they are further distinguishable by the ventral area being white instead of like the flanks as in the red brockets.

Pelage. The pelage of the red brockets is short, thin, and rather stiff in the forms of the tropical lowlands, but longer and thicker and less rigid in the mountain forms. In the brown brockets it is longer and softer than in the red species, the hair being distinguished by the early authors as, respectively "hard" in the red and "soft" in the brown species. Both seasonal and individual color variation seem more marked in the brown species than in the red, as in the amount of fulvous suffusion, and especially in the varying distinctness of the white spot over the front of the eye, which is in some species conspicuous, in others wholly absent. In the Santa Marta form the light eye spot is subject to wide individual variation, being sometimes a well-defined white mark, often indistinct but traceable, and sometimes wholly absent. In some of the other forms it appears to be always absent, in others always present.

A conspicuous feature in some of the red brockets is the reversed direction of the hair on the back of the neck, common to many of the forms of this group but absent in others, and apparently always absent in the brown group. It consists of an elongated hairwhorl in front of the withers, often extending thence forward for from several inches nearly to the whole length of the neck, in which the hair on the midline of the neck is directed outward and forward (mainly forward, or 'reversed'). This reversed condition may be present or absent in different individuals of the same species from the same locality, and therefore is not of great value as a morphological character. In a series of eight specimens of *Mazama tema cerasina* from Nicaragua the nape hairs are reversed in six of them, and a similar proportion prevails in a like series of *M. tema reperticia* from Panama. Those with the hair reversed in these series include both males and females, and also fawns in spotted coat, showing that the condition of reversed or non-reversed hair on the nape is not a feature of sex or age. On the other hand, in the *M. rufina* or subparamo group, in which the hair on the neck is much thicker and much longer, this reversal of the nape hairs is apparently always absent. Nor has it been noted in several other species of the red group. In a large series of the brown brocket of Santa Marta none have the nape hairs reversed, nor are they reversed in any other species of the brown group, so far as my limited material (about 20 specimens) gives evidence.

Antlers. The antlers, normally a single tapering spike, vary greatly in development even in adult males of the same species, and are so nearly alike in size and general character in both the red and brown species that they are not diagnostic. They vary in length (measured from the burr) in fully adult males from the same locality (*e. g.*, Santa Marta) from two to nearly five inches (55 to 115 mm.). The longest pair of antlers belongs to the single specimen from Paraguay (135 mm.); both species are members of the brown group. In both groups there is a marked tendency to malformations, through the broadening of the burr and basal portion of the antler, the shortening of the shaft, and the development of large accessory tubercles at the base. The exterior of the shaft is subject to great variation, being in some cases smooth and polished and nearly circular in crosssection, in others roughened with sharp ridges and more or less triangular in cross-section.

Teeth. G. Cuvier,[1] in discussing the characters of supposed species, laid great stress on the presence or absence of canines in the upper jaw, and in this he was followed by various subsequent authors. Later Pucheran[2] reached the conclusion that they were evanescent, being usually present in young animals and absent in adults. Brooke,[3] in his diagnosis of the subgenus *Coassus* (= *Mazama*) stated: "Canines of uncertain occurrence." My material (more than 60 skulls) confirms Pucheran's opinion that they are essentially a feature of the milk dentition, they being rarely present in skulls of mature animals. I have found only three instances of their presence in some 50 adult skulls, in two of which only one canine was present in each, in the other both. In young skulls with milk dentition in tact, both canines are usually present in both sexes; they usually disappear during the development of the molars, but the alveoli remain more or less distinct till the permanent dentition is fully developed, and sometimes they can be plainly seen in adult skulls.

The molars usually show no trace of a supplementary column (on the inside of the upper and on the outside of the lower); there is frequently a vestige on one or more of the teeth, and very rarely a strong column on each molar, which forms part of the enamel pattern as the teeth become worn.

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[1] Ossem. foss., 2d ed., IV, 1823, p. 53–55.
[2] Arch. du Mus. d'Hist. nat. Paris, VI, 1852, p. 480.
[3] Proc. Zool. Soc. London, 1878, p. 924.

But this feature evidently has no diagnostic significance, being merely individual.

Skull. Among the brockets there are long-nosed and short-nosed forms both among the red and the brown species, and while this difference is not a group feature, it is characteristic to a certain extent of species and subspecies. The amount of variation in this respect can be easily expressed by ratios. In the short-nosed species the ratio of the preorbital length (tip of premaxillaries to front edge of orbit) to the condylobasal length of the skull is about 50%, in both red brockets and brown brockets. In other species the ratio is sometimes as high as 56%, and such species are also represented in both groups. About 53% is the average ratio. (See the Table of comparative measurements of skulls at the end of this paper.)

The brockets, like other deer,[1] present a wide range of individual variation in certain cranial characters, especially in those of the preorbital portion of the skull. The range of individual variation in the size of the skull is usually small, as is also the amount of sexual variation in size. In the fine series of the brown brocket of the Santa Marta district of northern Colombia, the males average slightly larger than the females, but the largest skull of the series is that of a female. Five adult male skulls range in total length from 180 to 186 mm., five adult female skulls from 175 to 187; condylobasal length, males 167 to 181, females 167 to 180; occipitonasal length, males 155–165, females 155 to 165 mm. The zygomatic breadth in the same skulls varies in the males from 77 to 82, in the females from 75 to 79 mm. The orbital breadth varies in the same series from 3 mm. less to 4 mm. more than the zygomatic breadth, and the occipital breadth is from 1 to 4 mm. less than the width of the braincase.

The nasals, in respect both to relative size and to form, are an exceedingly variable element, varying in length from 50 to 58 mm., and in breadth from 23 to 28 mm., but the long nasals are sometimes narrower than some of the short ones. They vary in outline on the posterior border from slightly to deeply emarginate; on the front or apical border from obtusely rounded (about 40% of the series) to doubly emarginate (about 40%), in which the central (inner) points extend much beyond the outer, or all four points may be of nearly equal length, giving a symmetrically double-emarginate front border; in others (about 20%) the anterior border is variously intermediate in form between these two strongly contrasting outlines.

The varying subbasal width of the nasals greatly modifies the size and form of the antorbital vacuity, which is twice larger in some specimens than

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[1] See exposition of the case of *Odocoileus sinaloæ*, described and illustrated in this Bulletin, Vol. XXII, pp. 203–208, pll. xxiii–xxiv, July 25, 1906.

in others comparable with them in age and sex. It is evident, however, that age influences to some extent the size and shape of the vacuity through the gradual extension of the margins of the bones that form its boundaries, as the lacrymals, the nasals especially, and to a less extent the frontals and maxillaries, the size of the fossa thus tending to decrease with progress toward senescence. Thus in specimens of the same species the size of the lacrymal vacuity may be two or three times larger in some than in others.

The premaxillaries, in specimens of the same species, may present a broad junction with the nasals (in one case for a space of 10 mm.) or merely meet them (as in about 50% of the Santa Marta series), or terminate 2 or 3 to 10 mm. below them. In some species (of each color group), in which the number of specimens available for examination is small, the normal condition seems to be complete junction of the premaxillaries with the nasals.

The lacrymal pit also proves to be a highly variable character, being sometimes deep and well-defined and sometimes indistinct or nearly obsolete in specimens of the same subspecies.

It is therefore evident that the relative size and form of the nasals, the size and contour of the antorbital vacuity, the junction or otherwise of the premaxillaries and nasals, and the depth of the lacrymal pit are extremely untrustworthy as diagnostic characters, although they often enter into the diagnoses of species and subspecies.

Species and Subspecies. With the present lack of material available in even the largest museums, the discrimination of species and subspecies of the *Mazama* group must depend largely upon the experience and point of view of the describer with respect not only to the importance and probable constancy of the differences noted but also the geographical conditions involved. For example, *Mazama rufina* of Mount Pichincha in Ecuador and *M. brincenii* of the paramo of the Sierra de Merida in Venezuela so closely resemble each other in size, in coloration, and in the peculiar character of the pelage, that if their known ranges were contiguous they would naturally be regarded as local forms of a single species, but their wide separation by regions of much lower elevation and very different climatic conditions renders improbable any continuous distribution and consequent geographical intergradation. On the other hand four forms of red brocket are recognized in the present paper from Ecuador alone, one of which is from the paramo of Mount Pichincha and one from the tropical coast district. One of the others is from the eastern slope of the Andes, the other from the western. Three of them are large forms, some of which, or perhaps all, may be found to intergrade when material in proper amount becomes available from intermediate points. In this case, as with most of the other forms here recognized, it seems best to treat them nomenclatorially as full species. As these deer are difficult for even the professional collector to capture they must remain for a long time imperfectly known. Both brown and red brockets have been known for three fourths of a century to occur throughout the greater part of Peru but the number, character, and relationships of the forms inhabiting this diversified area are at present quite unknown. The same is also true of other vast areas of South America.

Prior to 1850 all the brockets known were currently referred to two species. In 1878 Sir Victor Brooke, in his review of the Cervidæ,[1] recognized six, but only four of them as well established. He says of them (*l. c.*, p. 926): "It is now many years since I commenced the study of this difficult group of Cervidæ; but although I have examined the specimens contained in nearly all the continental museums, and made a private collection of some importance, I must confess that I am still far from a satisfactory understanding of the subject. The complete absence of cornual and cranial characters renders it exceedingly difficult to grasp the characteristic peculiarities of the different modifications of the form, six or seven of which are, I think, probably persistent, and worthy of specific recognition by naturalists." Lydekker, in 1898,[2] recognized seven species, but only six of them are well founded.

In the present paper 24 forms are recognized as probably valid, of which 7 are here first described, while 6 of the others have been described within the last three years. Following is a list of them with their type localities.

Species and Subspecies of Mazama with their type localities.

RED BROCKETS.

Mazama trinitatis sp. nov. Caparo, Trinidad (p. 532).

Mazama americana americana (Erxleben). Cayenne (p. 533).

Mazama americana tumatumari subsp. nov. Tumatumari, British Guiana (p. 536).

Mazama americana juruana subsp. nov. Rio Juruana, Venezuela, near border of British Guiana (p. 537).

Mazama rufa rufa (Illiger). Paraguay (p. 538).

Mazama rufa jucunda Thomas. Sierra do Mar, Paranà, Brazil (p. 539).

Mazama sheila Thomas. Lowlands near Merida, Venezuela (p. 539).

Mazama rufina (Pucheran). Val de Lloa, western slope of Mount Pichincha, Ecuador (p. 540).

Mazama bricenii Thomas. Paramo de la Culata, Merida, Venezuela (p. 540).

Mazama sartorii sartorii (Saussure). Mirador, State of Vera Cruz, Mexico (p. 541).

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[1] On the Classification of the Cervidæ, with a Synopsis of the existing Species. Proc. Zool. Soc. London, 1878, pp. 883–928, pl. lv, text fig. 1–19.

[2] Deer of All Lands, pp. 298–306.

Mazama sartorii cerasina Hollister. Talamanca, Costa Rica (p. 542).

Mazama sartorii reperticia Goldman. Gatun, Canal Zone, Panama (p. 542).

Mazama zetta Thomas. Medellin, Antioquia, Colombia (p. 544).

Mazama gualea sp. nov. Gualea, Ecuador; altitude 6000 feet (p. 545).

Mazama fuscata sp. nov. Rio de Oro, Manavi, Ecuador; altitude near sea-level (p. 545).

Mazama zamora sp. nov. Zamora, southeastern Ecuador; altitude 2000 feet (p. 546).

Brown Brockets.

Mazama simplicicornis (Illiger). Paraguay (p. 547).

Mazama murelia subsp. nov. Murelia, Caquetà district, southeastern Colombia; altitude 600 feet (p. 547).

Mazama tschudii (Wagner). Peru (p. 548).

Mazama nemorivagus (F. Cuvier). Cayenne (p. 548).

Mazama superciliaris (Gray). Para, Brazil (p. 549).

Mazama cita cita Osgood. El Panorama, eastern side of Lake Maracaibo, Venezuela (p. 550).

Mazama cita sanctæ-martæ subsp. nov. Bonda, Santa Marta district, northern Colombia (p. 550).

Mazama pandora Merriam. Tunkas, Yucatan (p. 551).

Mazama *Rafinesque.*

Mazama Rafinesque, Amer. Monthly Mag., I, p. 263, Sept. 1817. Type *Mazama pita* Rafinesque (1817) = *Cervus rufus* Illiger (1815) = *Gouazou-pita* Azara.

Synonyms: *Subulo* Ham. Smith (1827); *Coassus* Gray (1850); *Doryceros* Fitzinger (1879); *Nanelaphus* Fitzinger (1879) = *Mazama* part + *Pudu* part. Type, *Nanelaphus namby* Fitzinger = *Mazama simplicicornis* (Illiger), by designation of Lydekker (1898).

The short, simple, spike-like antlers of the males, the small, slightly expanded bullæ in comparison with those of *Odocoileus* and *Blastocerus,* the flat and usually nearly straight (not arched and expanded) upper border of the orbits, the slight over-hang of the frontals over the postorbital fossa, together with small size and the red coloration of most of the species, large rhinarium, and absence of the metatarsal tuft, are the principal characters that distinguish the species of *Mazama,* the form of the antlers, when present being the obvious distinctive feature of the group. Skulls of large females of the brown group might easily be mistaken for female skulls of the smaller forms of *Blastocerus* and *Odocoileus,* but the form of the superior border of the orbits and the small uninflated audital bullæ serve readily for their separation. The coloration and texture of the pelage in the brown group adds further resemblance, on casual inspection, of females to the females of the South American species of *Odocoileus.* The enamel pattern of the last molars will readily separate skulls of *Mazama* from those of *Blastocerus,* but not from those of *Odocoileus.* The members of the red group are not readily separable from the members of the brown group by the skulls; in some cases it would be impossible to identify skulls without the skins belonging to them as being either red or brown brockets. Coloration, and usually the character of the pelage, are the only distinctions that will serve to separate them.

Red Brockets.

Mazama trinitatis sp. nov.

?Cariacus, sp. Thomas, Journ. Trinidad Field Nat. Club, I, No. 7, p. 7 of separate, April, 1893.

Cariacus (*Coassus*) *nemorivagus* Allen and Chapman, Bull. Amer. Mus. Nat. Hist., V, p. 228, Sept. 21, 1893. Skull only.

Mazama rufa (F. Cuvier) Allen and Chapman, ibid., IX, p. 22, Feb. 26, 1897. Skin and skull.

Type, No. $\frac{7545}{5939}$, ♀ ad., Caparo, Trinidad, March 13, 1894; Frank M. Chapman.

Size large. Pelage thin, hairs of the nape reversed. Premaxillaries broadly in contact with the nasals.

General color of upperparts of body cinnamon rufous, paler on the sides and much paler on the belly; throat and inguinal region white; tail above like the back, white below; legs dull cinnamon brown, somewhat lighter posteriorly; ears dull brown, externally the hairs very short; crown dark brown, the hairs tipped with rufous; no white eyespot; white on lips greatly restricted.

Collector's measurements: Total length, 1118 mm.; tail vertebræ, 127; height at shoulder, 645; girth, 711; fore leg, 396; ear, 89; tip of nose to base of ear, 205.5. Weight, $80\frac{1}{2}$ pounds, including a fœtus which weighed 6 pounds.

Two skulls, adult female (type) and adult male: Total length, ♂ 220, ♀ 210; condylobasal length, ♂ 210, ♀ 203; occipitonasal length, ♂ 188, ♀ 178; preorbital length, ♂ 115, ♀ 104; zygomatic breadth, ♂ 99, ♀ —; orbital breadth, ♂ 100, ♀ 92; interorbital breadth, ♂ 48, ♀ 42; occipital breadth, ♂ 65.5, ♀ 61.5; breadth of braincase, ♂ 62.5, ♀ 60.7; nasals, ♂ 63 × 29, ♀ 63 × 25; maxillary toothrow, ♂ 68, ♀ 62.5; m^{1-3}, ♂ 30, ♀ 28; right antler from burr, 118; diameter of burr, 21.6; pedicel (inside), 12. In the female skull (type) the teeth are much worn, but in the male skull they are only slightly worn.

Represented by the skin and skull of an old female (the type) and the skull of an adult male.

In size *M. trinitatis* closely approaches *M. americana tumatumari* of Guiana, the largest of the red brockets, but while the latter is dark chestnut red in general coloration, with the top of the neck, head, and ears nearly black, in strong contrast with the body, the color of *M. trinitatis* is light cinnamon rufous, with the top of the neck as light colored as the body, and the head and ears only a little darker, and hence not in strong contrast with the general coloration.

Mazama americana americana (*Erxleben*).

Moschus americanus Erxleben, Syst. Reg. Anim., 1777, p. 324. Primarily, *Cervula surinamensis* Seba.

Mazama americana Thomas, Ann. and Mag. Nat. Hist. (8), XI, p. 586, footnote, June, 1913 = *Cervus rufus* auct. (ex F. Cuvier). Not *Mazama americana* Osgood, Field Mus. Nat. Hist., Zool., X, No. 5, p. 43, footnote, Jan. 10, 1912 = *Cervus nemorivagus* F. Cuvier.

Cervus rufus F. Cuvier, Dict. Sci. Nat., VII, 1817, p. 485, part (the Cayenne specimens, not *Gouazoupita* Azara). Not *Cervus rufus* Illiger = *Gouazoupita* Azara.

Cervus rufus Pucheran, Arch. du Mus. d'Hist. nat. Paris, VI, 1852, pp. 471–478, part.

Cervus (*Subulo*) *dolichurus* Wagner, Suppl. Schreber's Säug., IV, 1844, p. 389, footnote = large form of red brocket recognized by G. Cuvier from Cayenne (Ossem. foss., ed. 2, IV, 1823, pp. 45 et seq.).

Type locality, Cayenne.

The best descriptions available of the red brocket of Cayenne are G. Cuvier's (*l. c.*, pp. 53, 54) and Pucheran's (*l. c.*), from which it is evident that the red brocket of Cayenne differs essentially in coloration, and probably in other features, from the red brocket of the northern coast region of British Guiana. In the absence of Cayenne specimens I transcribe Pucheran's diagnosis and description, as follows:

"Pelage roux vif en dessus, brun rougeâtre dans la région thoraco-abdominale. Queue de longueur moyenne, présentant supérieurement la même coloration que le dessus du corps, blanche en dessous. . .

"Le poil dans ce type est dur et de couleur roux vif en dessus, à teinte moins foncée sur les parties latérales. Le pelage est plus flexible en dessous, et de couleur brun rougeâtre. Il est blanc sur la région ano-génitale, à l'intérieur des fesses et des cuisses; dans cette dernière région, le blanc est très-lavé de fauve. Du brun fauve existe également à l'intérieur de la moitié supérieure du membre autérieur, sur le dessous du cou et de la machoire inférieure, où le blanchâtre reparaît d'une manière saillante. Le dessus du cou est brun foncé. Il existe une petite tache blanche à l'extrémité de la levre inférieure; en arrière d'elle, se trouve une bande transversale d'une brun roux un peu foncé. L'orbite est entourée d'une peau très-dénudée. Du brun fauve existe sur les côtés de la tête, du brun obscur tirant au roux sur le dessus, ainsi que sur la face externe des jarrets et des oreilles. La queue est, en dessus, couverte de poils d'un brun rougeâtre et très-flexibles, blanche en dessous."— Pucheran, *l. c.*, pp. 471, 472.

Pucheran gives a detailed table of the external measurements of a specimen from Cayenne, in which the total length is recorded as 1340 mm.; tail vertebræ, 120; length of ears in front, 62, at back, 65. He gives no measurements of the skull, which, however, are given by Sir Victor Brooke (Proc. Zool. Soc. London, 1878, p. 925) for his *Cariacus* (*Coassus*) *rufus*, as: Total length, 235 mm.; preorbital length, 124; length of maxillary toothrow, 68; orbital breadth, 80. Based on an adult female skull, presumably from "Surinam."

The red brocket of Guiana (*i. e.*, French Guiana, or Cayenne) is the

Cervus rufus of F. Cuvier [1] (1817), but this name is preoccupied, as already shown (*supra*, p. 523) by *Cervus rufus* Illiger (1815), based exclusively on the red brocket of Paraguay, the *Gouazoupita* of Azara. The only other name that has been applied to it is *Cervus* (*Subulo*) *dolichurus* Wagner, based on the larger of the two brockets distinguished by G. Cuvier.[2] Hitherto it has almost universally been known as *Cervus* (or *Subulo*, or *Coassus*, or *Mazama*) *rufus* of F. Cuvier, but recently attempts have been made (as indicated in the citations given above) to substitute therefor Erxleben's *Moschus americanus* (1777). In order to ascertain the real basis of this name I have looked up and collated all of Erxleben's citations under this species, and am convinced that *Moschus americanus* should be accepted as a valid name, on the basis of Seba. In order, however, to show its exact basis, and also to illustrate the nature of the descriptions and records left by the eighteenth century authors cited by Erxleben in this connection,[3] I give below literal transcripts of all the passages bearing on the question, as follows:

1731. **Des Marchais.**

Biche de Guiane *Des March.* voy. III p. 281.

Des Marchais's account [4] of his "Biche Guiane" occupies about two pages, the substance of which is that this animal is a small deer, without antlers in either sex. There is not a word that has any value in a distinctive sense. About one third of the account is given to a statement of why the French inhabitants of Guiane (*i. e.*, Cayenne), call the animal *biche*. Another third relates to its size and conformation, and the other third to how it is hunted and the value of the flesh and skin to its captors. The essential part, from a taxonomic point of view, is the following (from p. 282):

"Ils sont très vif, très legers à la course, timide à l'exces. Ils sont couverts d'un poil fauve rougeâtre, asse court & épais. Ils ont le tete petite, décharnée, les oreilles minces, le col long & arqué, les pied fourchu, le queue court, la vuë perçante. . . ."

This is not definitive, vaguely indicating a small reddish deer as occurring in Guiana.

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[1] F. Cuvier (*l. c.*) says "Les têtes de ces deux espèces [his Cervus *rufus* and *Cervus nemorivagus*], envoyées par M. Martin au Muséum d'Histoire naturelle, en ont bien fait connoitre les caractères." G. Cuvier (*l. c.*, p. 53) further says: "MM. Martin et Poiteau nous ont envoyé en abundance, des grandes forêt de Cayenne, sous le nom de *biche de bois*," etc. These included both large and small specimens, small ones having also been sent from Brasil by Laland and Auguste de St. Hilaire, but no large ones. Pucheran (*l. c.*, p. 474) makes the same statement.

[2] Ossements fossiles, 2d ed., IV, 1823, p. 53. For extended comment on the large and small brockets distinguished by G. Cuvier, and the later complications connected therewith, see Pucheran, *l. c.*, pp. 474–477.

[3] Eight in number, ranging in date from 1731 to 1771, the authors being: 1 Marchais, 1731; 2, Seba, 1734; 3, Klein, 1751; 4, Brisson, 1756; 5, Hallen, 1757; 6, Diction. Anim., 1759; 7, Bancroft, 1769; 8, Pennant, 1771.

[4] Voyage du Chevalier Des Marchais en Guinée, Isles voicines, et à Cayenne, fait en 1725, 1726, 1727. . . . Par C. R. Père Labat. Vol. III, 1731, pp. 281–283.

1734. **Seba.**

Cervula surinamensis, albis macula notata *Seb. thes. I, p.* 71 *tab* 44 *fig.* 2.

"Num. 2, Cervula, Surinamensis, subruba, albis maculis notata.

"Caput, pectus, abdomen, & pedes exceperis, quæ unicoloria sunt; reliquum, ex ruffo luteum, maculis albis undique, Tygridis in modum, variegatur. Auriculæ grandes, longæ: cauda brevis, obtusa. Cursûs rapiditate incredibili vel magnum Cervum superat. Memorabile est, Cervos Americanos adeò pusillos esse: quum, dentur, leporem qui magnitudine haud excedunt; & omnium maxima species altero tanto circiter major sit, quàm quæ hâc Tabulâ repræsentatur. Cornua verò nunquam gerunt, & pro sapidissimâ ferinâ habentur."

This clearly indicates a small reddish deer, spotted with white, of Surinam; in all probability a faun of the red (not the brown) brocket of Surinam.

1751. **Klein.**

Tragulus surinamensis *Klein. quadrup. p.* 22. Based exclusively on Seba.

1756. **Brisson.**

Le Chevrotain de Surinam: Tragulus (surinamensis) ex rufo luteus, macula albis variegatis *Briss. regn. an. p.* 96, *n.* 3.

Based exclusively on Seba and Klein, therefore primarily on Seba.

1757. **Hallen.**

Das Surinamische rothliche Hirschen mit weissen Flekken und langen Ohren *Hall vierf. p.* 321.

Not seen, but obviously from Seba.

1759. **Dictionn. etc.**

Chevrotain de Surinam *Dictionn. anim.* I, *p.* 602.

This edition not seen, but in a later edition (1776) this reference is based exclusively on Klein, therefore originally on Seba.

1769. **Bancroft.**

The Wirrebocerra *Bancr. Guian. p.* 123.

"Of deer, in *Guiana*, there are two kinds, one large, and the other small. The former is both by the Natives and *Europeans* termed *Baieu*, and the latter Wirrebocerra. The Baieu is a stag, about the size of the *European* Buck,..." (p. 122). "The Wirrebocerra is at least one third less than the Baieu, and entirely destitute of horns. These seem to be of the same species which Father *Labat* describes at Cayenne.[1] Their whole structure is extremely slender and delicate. Their heads are small, ears narrow and short, necks long and arched, eyes lively and piercing, tails small and short, feet cloven, and their legs slender and nervous, and peculiarly adapted to that velocity of motion, by which alone they are able to preserve themselves from the attacks of the Tiger and other voracious animals, whom the great delicacy of their flesh has rendered their enemies. They are covered with a short soft hair, of a reddish fallow colour...." (pp. 123, 124).

The above is Bancroft's entire description in so far as it relates to the physical characters of the Wirrebocerra, which may be only a female or a young male of his Baiew. The evidence is not conclusive that it is a brocket, and less so that it is a red brocket. The only tangible character given is that the "short soft hair" is of "a reddish fallow colour." The few words of description are obviously from Des Marchais (*l. c., supra*).

"[1] Voyage du Chev. de Marchais en Guinée & à Cayenne, &c." [See above, the first citation.]

1771. **Pennant.**

The Brasilian Musk *Penn. syn. quadr. p.* 58 *n.* 47.

A compilation, based on the following seven authors: Margrave, Piso, Marchais, Bancroft, Seba, Klein, Brisson. The gist of his description is: "About the size of a roebuck; both sexes without horns; hair short and smooth; head and neck brown; throat and *lower part of neck* white; body and legs tawny. Inhabits Guiana and Brazil." This agrees, so far as it goes, better with the brown brocket than with the red brocket, especially in "the lower part of the neck" being white.

Pennant evidently derived some of his account from Marcgrave's description of the Cuguacu-ete (Brazil, etc., p. 235). Erxleben cites Marcgrave's Cuguacu-ete only among the references given by him under *Cervus capreolus* as "Hunc pertinere videntur."

Erxleben's own diagnosis is as follows: "M. rufo-fuscus, ore nigro, gula alba." His description, so far as it has significance, is: "Pili breves mollesque, capitis collique supra fusci, colli subtus albi, corporis crurumque rufo-fusci. . . . *Habitat* in Guiania et Brasilia."

To summarize the foregoing: Erxleben's *Moschus americanus* was obviously based primarily on Seba, his second citation; four of his other citations rest exclusively on Seba; two of the others are worthless; the reference to Pennant brings in a new element, Marcgrave,[1] not cited by Erxleben under *Moschus*, but doubtfully under *Cervus capreolus*. Otherwise Pennant adds nothing to the case.

Mazama americana tumatumari subsp. nov.

Cervus rufus auct., part.

Type, No. 36350, ♀ ad., Tumatumari, British Guiana, Aug. 8, 1913; Leo E. Miller.

Upperparts of body dark chestnut rufous; ventral surface much duller and paler; a broad black dorsal line begins behind the shoulders and runs forward on the upper side of the neck to the head; sides of the neck dull rufous; front of neck and throat buff; upper surface of head and ears nearly black; inner surface of thighs white; front of limbs blackish brown, nearly black on the hind limbs; tail like rump above, white below.

No external measurements appear to have been taken by the collector.

Measurements of the skull of the type (adult female): Total length, 234 mm.; condylobasal length, 222; occipitonasal length, 190; preorbital length (anterior border of orbit to tip of premaxillaries), 124; zygomatic breadth, 92; orbital breadth,

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[1] Aside from the references to size and form, which are not diagnostic, the essential part of Marcgrave's description of his "Cuguacu-ete Brasiliensibus" is: "Pilis vestiter glabris, qui in toto corpore, cruribus & pedibus rufescunt, in collo & capite fusci, sub guttere & inferiori collo albo." G. Cuvier (*l. c.*, p. 56) summarizes Marcgraves description and adds "Voilà sans contredit, la femelle de notre petite espèce rouge-bai."

Kerr's *Cervus caguete* is based on Marcgrave's Cuguacu-ete, and this name may be considered available (as *Mazama caguete*) for the red brocket of the Pernambuco district of eastern Brazil, should it prove distinguishable from the red brockets of Surinam and southern Brazil

91; interorbital breadth, 51; occipital breadth, 72.5; breadth of braincase, 67; maxillary toothrow, 73.5; m^{1-3}, 42.

This is much the largest and one of the darkest forms of the red brocket known to me, *M. d. juruana* (described below) being the next in size, while *M. fuscata* of the coast region of Ecuador is still darker. It evidently differs much in coloration from the red brocket of Cayenne, described in great detail by G. Cuvier (*l. c.*) and again by Pucheran (*l. c.*), both of whom give the color of the body above as bright rufous, and make no mention of the dark or blackish color of the legs, which is a conspicuous feature in the form here described, the legs being blackish instead of merely "brun foncé." Season, or rather the condition of the pelage, may make some difference with the coloration, the freshly acquired coat being doubtless more deeply toned than the same coat would be at the end of several months, or just before the moult, but in series of specimens of other species of brockets taken at different seasons of the year there is no very marked difference. On the other hand, individuals taken in the same month of the year may present quite a strong difference in coloration, but not so great as between the type specimen of *tumatumari* and Cayenne specimens, as described by the Cuviers and by Pucheran.

Mazama americana juruana subsp. nov.

Mazama rufa Allen, Bull. Amer. Mus. Nat. Hist., XXX, p. 247, Dec. 2, 1911.

Type, No. 30624, ♀ ad., Rio Juruan, Venezuela (near Guiana boundary), March 21, 1910; M. A. Carriker, Jr.

Size large; hair on nape reversed. Upperparts intense bright rufous, slightly darker on back, a little paler on sides; back of neck and top of head dull brownish, the long hairs on the crown tipped with rufous; the usual patch of white on the upper lip bordering the rhinarium; sides of head and neck dull pale buffy brown; chin, throat, and fore neck whitish with a buffy tinge; interramial space with a pale rusty patch opposite the angles of the mouth; breast and belly rufous like the flanks; inguinal region and lower abdomen white, the white extending down the inside of the hind legs in narrowing band nearly to the hocks; outside of limbs dull brown, nearly like back of neck, fading to pale yellowish rufous on the metatarsus and digits; tail above bright rufous, white below; ears dark brown externally, white laterally at the base with a slight fringe of white.

Collector's measurements: "Length, 4 ft. 7 in. [1140 mm.]; tail, 6 in. [154]; circumference of chest, 2 ft. 5 in. [785]; height at shoulders, 2 ft. 8 in. [812]."

In general size the skull agrees well with a female skull of *M. americana tumatumari* from British Guiana, but the maxillary toothrow is much shorter and some of the transverse measurements are much greater, others less, as follows: Total length (Juruan skull), 228; (Guiana skull), 234; condylobasal length, 214, 222; occipito-nasal length, 194, 190; preorbital length, 116, 124; zygomatic breadth, 100, 92; orbital breadth, 100, 91; interorbital breadth, 45, 51; occipital breadth, 65, 72.5;

breadth of braincase, 65, 67; length of nasals, 67.5, 69; breadth of nasals, 23, 24; maxillary toothrow, 61.5, 73.5; m^{1-3}, 27, 42. While the condylobasal length is 8 mm. less than in the Guiana skull, the zygomatic breadth is 8 mm. more, and the length of the maxillary toothrow 12 mm. less. On the other hand the braincase and occiput are narrower.

The short toothrows and the short preorbital length, combined with the great zygomatic and orbital breadth are features that may require confirmation by additional material, but the two skulls from Tumatumari both differ similarly from the Rio Juruan one, and the difference is unusual, both in kind and degree, from ordinary individual differentiation. There is also much difference in the coloration from that of either *tumatumari* or *americana*.

Mazama rufa rufa (*Illiger*).

Cervus rufus Illiger, Abhandl. k. d. Akad. Wissen. zu Berlin, III, 1811 (1815), p. 108 (nom. nud.), p. 117 = *Gouazoupita* Azara.

Mazama pita Refinesque, Amer. Monthly Mag. I, p. 363, Sept. 1817 = *Gouazoupita* Azara.

The seven specimens of red brockets obtained on the Roosevelt Expedition to South America in southwestern Matto Grosso are doubtless referable to typical *Mazama rufa* (type locality, Paraguay). Unfortunately the field numbers on the skulls were lost before the specimens reached the Museum, and hence the skins and skulls cannot be correlated with certainty. The specimens are as follows: Three females (2 adult, 1 young), Urucum, near Corumbá, Dec. 6–13 (Miller and Cherrie); 4 males, 3 adult, 1 young (the latter skull only), Porto Campo, Rio Sipotuba, Jan. 7 (T. and K. Roosevelt).

The field measurements of 2 males and 2 females (all adult) give the total length as follows: ♀ 1100, ♀ 1420, ♂ 1050, ♂ 1350.

Two adult female skulls from Urucum: Total length, 207, 217; condylobasal length, 198, 208; occipitonasal length, 175.3, 184; preorbital length, 107, 113; zygomatic breadth, 90, 93; orbital breadth, 86.5, 92.7; interorbital breadth, 44, 45; occipital breadth, 58, 59; breadth of braincase, 60.5, 59; nasals, 62.5 × 28.5, 66 × 20; maxillary toothrow, 62.5, 61.5; m^{1-3}, 29, 27.5. Ratio of preorbital to condylobasal length, 54, 56.3.

Three adult male skulls (the two larger with the teeth much worn) from Porto Campo: Total length, 213, 206, 209; condylobasal length, 203, 193, 196; occipitonasal length, 184, 172, 178; preorbital length, 111, 102, 106; zygomatic breadth, 90, 91, 93; orbital breadth, 92.5, 91.5, 94; interorbital breadth, 45.3, 45, 49; occipital breadth, 59, 57, 62; breadth of braincase, 61.5, 62, 62.7; nasals, 78.5 × 28, 58.5 × 21, 65 × 26; maxillary toothrow, 60, 60.5, 59. The length of the antlers (from burr to tip) in two specimens is 94 and 78; in the other male the antlers had recently been shed when the animal was killed. Ratio of the preorbital to the condylobasal length, 55.4, 53.6, 55.6.

Three adult male skulls from Chapada, Matto Grosso, are similar in size and in other features, and are doubtless referable to this form.

The general coloration of the upperparts is pale rufous, deepest on the back and paler on the sides and belly; the head and back of the neck are dusky brown. The skulls average about 25 mm. shorter than an adult female skull from Tumatumari, British Guiana, described above (*M. americana tumatumari*), and the coloration is everywhere much lighter; the limbs are colored like the body instead of being blackish as in the Guiana form.

Mazama rufa jucunda *Thomas.*

Mazama americana jucunda Thomas, Ann. and Mag. Nat. Hist. (8), XI, p. 587, June, 1913. Roça Nova, Serra do Mar, Parana, Brazil (alt. 1000 m.).

"Similar in general characters to the ordinary *M. americana* of eastern South America (*M. rufa auctorum*), but the skull conspicuously shorter. Fur of medium length; nape hairs reversed (one skin only). Colour above of head and neck brown, of body bright rufous fawn, not very unlike that of *M. zetta*. Under surface, as usual in this group, whitish on chin and throat, rufous, like back, on belly. Limbs brown proximally, rufous on the digits. Tail dark rufous above, white below."

The type is an immature female, but measurements of an adult male skull are given, as follows: "Condylo-basal length 178 mm.; zygomatic breadth 88; length of nasals 45 [in the immature female 57]; interorbital breadth 46; gnathion to front of anterior premolar 55; palatal length 109; breadth between sides of m^2 65; upper toothrow 61." — Thomas, *l. c.*

Closely related to typical *rufa*, but apparently rather smaller and somewhat paler than specimens from Matto Grosso.

Mazama sheila *Thomas.*

Mazama sheila Thomas, Ann. and Mag. Nat. Hist. (8), XI, p. 587, June, 1913.

Type locality, Montaña de Limones (altitude 50 m.), lowlands, near Merida, Venezuela.

"A small pale rufous ally of *M. americana*.

"Size conspicuously smaller than in *M. zetta*. Form about as in that species. Fur close and short. Nape-hairs not reversed (in the single specimen). General colour bright rufous (between orange-rufous and tawny of Ridgway). Muzzle, centre of crown, and neck brown, supraorbital lines rufous, not sharply defined. Ears pale brown, with distinct patches of white at the base of their inner edges. Chin and interramia, a patch on chest, and anal region whitish; rest of under surface rufous, like back. Fore limbs rufous throughout. Hind limbs rufous, but the metatarsals brown, darker posteriorly. Tail rufous above, white below.

"Skull of the same somewhat broad squat shape as in *M. zetta*, but far smaller. Premaxillæ not quite reaching to the nasals.

"Dimensions of the typical skull (adult, but not old):— Condylo-basal length 177 mm.; zygomatic breadth 85; length of nasals 48; interorbital breadth 39; gnathion to front of anterior premolar 58; palatal length 111; breadth between outer sides of m^2 63; upper toothrow 55.

"*Hab.* Lowlands near Merida, Venezuela. Type from the Montaña de Limones. Alt. 50 m.

"*Type.* Adult male. B. M. no. 13.24.4. Collected 17th October, 1910, by S. Briceno and Sons.

"This Brocket is readily distinguishable by its bright rufous colour, unreversed nape-hairs, and small size, as compared with its only near allies, *M. americana* and *zetta.*"— Thomas, *l. c.*

A young fawn from La Palma, Colombia, eastern slope of the southern end of the Eastern Andes, may be referable to this species. (See below, p. 545.)

Mazama rufina (*Pucheran*).

Cervus rufinus Pucheran, Rev. et. Mag. Zool. (2), III, p. 561, Nov. 1851; *ibid.*, Arch. du Mus. Paris, VI, 1852, p. 491, pl. xxx. "Vallée de Lloa, sur le versant occidental de la Cordillière du Pichincha."

One specimen, an old female with teeth much worn, a topotype of the species, Mt. Pichincha, May 15, 1913 (Richardson). Reliable external measurements are not available. Skull, total length, 161.5; condylobasal length, 151; occipitonasal length, 142.5; zygomatic breadth, 72; interorbital breadth, 36; mastoid breadth, 55.5; breadth of braincase, 51; maxillary toothrow, 48; m^{1-3}, 29.

This specimen is practically a topotype, as Richardson collected it in "Vallée de Lloa." It agrees with Pucheran's description and plate, except that Pucheran says the front of the legs is blackish, while in the present specimen there is a mixture of white on the lower tarsus and digits, probably an individual variation.

The hairs of the nape are not reversed, nor are they in a topotype of *M. brincenii.*

Mazama bricenii *Thomas.*

Mazama bricenii Thomas, Ann. and Mag. Nat. Hist. (8), I, p. 349, June, 1908. Paramo de la Culata, Merida, Venezuela; altitude 3000 m.

Represented in the present collection by a topotype (skin without skull).

This species and *Mazama rufina* (Pucheran) of the high Andes of Ecuador resemble each other greatly and differ from all the other known red brockets in their small size and very dark coloration and in the long coarse thick pelage. From their wide geographical separation and the similarity of their environment it would seem probable that their close resemblance is a case of parallelism in development.

Thomas's measurements of a skull (adult female): "Greatest length 159 mm.; basal length 143; greatest breadth 70; nasals 43.5 × 22.5; height of orbit 25; muzzle to front of p^2 45; combined length of three upper premolars 23.5, of whole toothrow 51."

Mazama sartorii sartorii *Saussure.*

?? *Cervus temama* KERR, Anim. Kingdom, 1792, No. 662 = *Tema-maçame* Hernandes.

?? *Mazama temama* ALLEN, Bull. Amer. Mus. Nat. Hist., VII, p. 191, June 20, 1895 = *Cervus tamama* Kerr.

?? *Mazama tema* RAFINESQUE, Amer. Monthly Mag., II, p. 44, November, 1817 = *Temamazame* Hernandez.— THOMAS, Ann. and Mag. Nat. Hist. (8), I, p. 349, footnote, April, 1898.

Cervus sartorii SAUSSURE, Rev. et Mag. de Zool. (2), XII, p. 252, June, 1860. Based on a skull from Mirador, Vera Cruz, Mexico.

Type locality, Mirador, State of Vera Cruz, Mexico.

An adult female skull from Palenque, Chiapas, Mexico (U. S. Nat. Mus. No. 100418) gives the following measurements: Total length, 174 mm.; condylobasal length, 160; occipitonasal length, 150; preorbital length, 83.5; zygomatic breadth, 80; orbital breadth, 77; interorbital breadth, 47.5; occipital breadth, 53.7; breadth of braincase, 56; nasals, 48 × 19; maxillary toothrow, 51.5; m^{1-3}, 29.5. Ratio of preorbital length to condylobasal length, 52.2.

This skull, the only material available of this species, indicates that the size of the Mexican red brocket is below the medium size for the genus, and somewhat less than in the Central American forms of the *sartorii* group.

There is no reason to question the applicability of the name *Cervus sartorii* Saussure to the red brocket of Mexico. On the other hand the applicability of Rafinesque's name *Mazama tema,* and of Kerr's earlier *Cervus temama,* to this species is not at all evident. Hernandez's description and figure scarcely indicate a red brocket, being much more likely to have been based on a young *Odocoileus* with spike horns, as long ago stated by Lichtenstein. Hernandez's entire description, aside from generalities, is as follows: "Deinde in quondam Damarum genere quas Macatlchichiltic, aut Temamaçame, appellant, brevissimis cornibus, acutissimisq; coloris fulvi, fusci, & inferne albi, quarum quoque præstita est imago."[1]

[1] Hernandez, F. Nova Plantarum, Animalium et Mineralium Mexicanorum, 1651, p. 325, with figure in text.

Hernandez's description and figure calls for an animal entirely white below, including the lower half of the sides of the head, and the light and shade of his figure agree with his description. Lichtenstein long since [1] claimed that Hernandez's account of his Maçama was not entitled to serious consideration, and expressed the opinion that it was a "Spiesser" of *Cervus mexicanus*, an opinion I feel forced to accept.

Mazama sartorii cerasina (*Hollister*).

Mazama tema Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 649, Oct. 13, 1908; *ibid.*, XXVIII, p. 95, April 30, 1910.

Mazama tema cerasina Hollister, Proc. Biol. Soc. Washington, XXVII, p. 209, Oct. 30, 1914. Talamanca, Costa Rica.

A series of 6 specimens from Tuma and Savala, Nicaragua (eastern slope, 800 to 1000 feet altitude), and 1 from San Juan Telpaneca, Nicaragua (north of Matagalpa, altitude 3500 feet), are referred to Mr. Hollister's recently described subspecies *cerasina* (type locality Talamanca, Costa Rica, but to which specimens from "Guatemala" are also referred). Also 1 specimen from Pozo Azul, Costa Rica.

Two of these specimens, the one from San Juan Telpaneca, taken in January, the other from Pozo Azul, taken in July, are very much darker than any of the others of the series, but, considering the wide separation of the two localities and the dates of collecting (January and July), they are doubtless only to be regarded as exceptionally highly colored examples. The "brown" (rufous brown) band on the chin, mentioned in the description of this form, is rarely noticeably present in my series, while the hairs on the back of the neck are strongly reversed in six of the eight specimens.

Five adult skulls from Nicaragua average, total length, 185 (180–190); condylobasal length, 174 (170–180); occipitonasal length, 161 (158–165); preorbital length, 88.5 (85–89.5); zygomatic breadth, 80.6 (77–86); orbital breadth, 79.1 (77–82); interorbital breadth, 39.2 (37–43.2); occipital breadth, 51.2 (48.5–54); breadth of braincase, 57.1 (56.3–58); length of nasals, 51.2 (47–55); breadth of nasals, 22 (19–22); maxillary toothrow, 56.2 (54–58); m^{1-3}, 26.9 (25–28).

The ratio of preorbital to condylobasal length is 48 (47.2–48.3).

Mazama sartorii reperticia *Goldman.*

Mazama tema reperticia Goldman, Smithsonian Misc. Coll., LX, No. 21, p. 2, Feb. 26, 1913.

Type locality, Gatun, Canal Zone, Panama.

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[1] Abhandl. Akad. Wissens. Berlin, (1827) 1830, p. 111.

Ten specimens, as follows: Chepigana, adult male, Dec. 3, 1914; El Real, young male, adult male, adult female, Jan. 6–28, 1915; Tapalisa, 3 adult females, Feb. 12–27; Boca de Cupe, adult female, April 30; Cituro, adult female, May 12; these localities are all in eastern Panama, at or near sea level (the highest, Tapalista, has an altitude of 400 feet), on the Rio Tuyra and its tributaries, Rio Cupe, and Rio Pucro. All were collected by W. B. Richardson.

There is also a young specimen, in spotted coat, from Curchirbo, Canal Zone, collected by H. E. Anthony, Feb. 12, 1914.

These specimens are all doubtless referable to *M. t. reperticia* Goldman, from the Canal Zone, a much lighter colored form than *M. t. cerasina* Hollister, from Talamanca, Costa Rica.

Unfortunately the skins are all without field measurements.

Two young adult males (teeth fully matured but not worn), total length, 182, 195 mm.; condylobasal length, 177, 178; occipitonasal length, 160, 170; preorbital length, 89, 91; zygomatic breadth, 83, 82; orbital breadth, 81.5, 82; interorbital breadth, 42.5; 40.5; occipital breadth, 53, —; breadth of braincase, 56, 59; length of nasals, 51, 58; breadth of nasals, 22.5, 22.5; maxillary toothrow, 59, 59; m^{1-3}, 28, 27.5; length of longest antler from burr, 39.

Three adult female skulls (teeth only slightly worn), total length, —, 190, 200.3; condylobasal length, —, 178, 183; occipitonasal length, —, 165, 178; preorbital length, 95.5, 92.5, 105; zygomatic breadth, 82.5, 83.6, 81; orbital breadth, 81.5, 83, 80.7; interorbital breadth, 40, 41, 43; occipital breadth, ——, 58, 59.3; breadth of braincase, 58, 60, 59; length of nasals, 65, 58, 63.5; breadth of nasals, 23.5, 29, 22.5; maxillary toothrow, 60, 58.3, 57.2; m^{1-3}, 28, 27, 25.2. The ratio of preorbital to condylobasal length in the two males is 50 and 52.2; in three females, 50.2, 52, 52.3, as compared with 48 in 1 adult male and 3 adult females in *M. s. cerasina*.

In 8 of the 10 skulls the posterior border of the nasals is broadly rounded, in the other 2 it is acutely pointed. The front border of the nasals is double emarginate in 9 of the 10 skulls and in the other tapers to a single median point. The premaxillaries reach the nasals, with a more or less broad junction, in 9 of the skulls; in the other they are wholly separated by a space of 5 or 6 mm. In the two younger of 3 skulls still retaining the milk dentition the canines are present, in the other (the oldest of the 3) the canine alveoli are widely open but the teeth have been shed. In none of the adult skulls are canines present, and in most of them the alveoli have wholly disappeared.

Mazama zetta *Thomas.*

Mazama tschudii Allen, Bull. Amer. Mus. Nat. Hist., XXXI, p. 74, April 19, 1912. Provisional reference.

Mazama zetta Thomas, Ann. and Mag. Nat. Hist. (8), XI, p. 586, June, 1913.

Type locality, Medellin, Antioquia, Colombia.

Two specimens, adult female and young in spotted coat, from Gallera, Colombia (altitude 5700 feet), "referred provisionally" by me in 1912 to *Mazama tschudii*, appear to agree quite satisfactorily with Thomas's description of *Mazama zetta* from Medellin. The female is fully adult, with much worn teeth. The fawn in spotted coat is very much darker than the adult.

Field measurements of the adult female: total length, 1180 mm.; tail vertebræ, 180. The skull measures, total length, 200; condylobasal length, 188; occipitonasal length, 173; preorbital length, 101; zygomatic breadth, 87.5; orbital breadth, 86; interorbital breadth, 40; occipital breadth, 60; breadth of braincase, 60; length of nasals, 64; breadth of nasals, 29; maxillary toothrow, 60; m^{1-3}, 27.3. Preorbital length 50% of the condylobasal.

Thomas's measurements "of fully adult male and female skulls," as far as they are comparable with the above, are: Condylobasal length, 187, 190; interorbital breadth, 42, 46; maxillary toothrow, 60, 61.

Two other specimens require mention in the present connection, both from the eastern slope of the southern end of the Eastern Andes of Colombia. Both are fawns in spotted coat, skins without skulls; one is much younger and smaller than the other, and it lacks head, neck, and feet. The younger one, apparently not more than a few days old when killed, is from La Candela (altitude 6500 feet), and has the ground color very dark and the white spots very sharply defined. The older one, still in spotted coat, from La Palma (altitude 5300 feet, a few miles east of La Candela), has the ground color very much lighter, the white spots less sharply defined, the pelage much coarser and longer, and the hairs of the nape not reversed. Compared with a fawn from Gallera, southern part of the Colombian Western Andes, (referred above provisionally to *M. zetta*), the coloration is strikingly different, the La Palma specimen being light yellowish rufous on the flanks and ventral surface, but the middle of the dorsal area and the top of the head are much darker. In the Gallera specimen the top of the head, top of the nape, and the dorsal area are dark brown with a faint dark rufous suffusion; the flanks are rufous; the fore neck, chest, and belly are much lighter, mostly dingy gray suffused with very pale rufous, the tips of the hairs lighter.

The two fawns, respectively from Gallers and La Palma, unquestionably represent different species, but the material is too unsatisfactory for positive identification. It is possible that the La Palma specimen may be referable to *M. sheila,* from the lowlands near Merida, as the coloration and unreversed nape hairs suggest that type.

Mazama gualea sp. nov.

Type No. 36473, ♀ adult, Gualea (altitude 6000 feet), Ecuador, June 2, 1913; W. B. Richardson.

Size large; coloration dark; hair of back of neck reversed. Upperparts near liver brown of Ridgway, darker over the middle region of the back, lighter and more tinged with rufous on the sides and underparts; back of neck and head (including ears) not darker than the middle of the back; a lighter band, tinged with rufous, over the eyes; the usual white patch on the lip bordering the rhinarium; chin whitish, bordered posteriorly with a broad band of dark brown, broken by whitish on the median line; throat dingy grayish white; foreneck drab gray; inguinal region and inside of thighs clear white, from which a white band descends on the inside of the hind limb nearly to the hock; limbs otherwise dark brown, like the upperparts; tail above like the back, white below; ears dark brown externally, whitish near inner base, and fringed with white internally.

Represented by the type from Gualea and another female from Mount Pichincha. In coloration the two specimens are essentially alike.

Collector's measurements: Total length (female, type), 1050 mm.; tail vertebræ, 50; hind foot, 290. Female, Mount Pichincha, total length, 1250; tail vertebræ, 60; hind foot, 290.

Skull (female, type, Gualea; young female, nearly adult, Mount Pichincha); total length, 195, 193; condylobasal length, 185, 179; occipitonasal length, 165, 163; preorbital length, 96.5, 96.5; zygomatic breadth, 86.5, 88; orbital breadth, 88, 84; interorbital breadth, 45, 45; occipital breadth, 65, 59; breadth of braincase, 60, 57.5; length of nasals, 56, 55; breadth of nasals, 27, 26.5; maxillary toothrow, 58, 63; m^{1-3}, 27, 29. The ratio of preorbital length to the condylobasal is, respectively, 52.3%, and 53.3%.

This form seems nearest related to *M. zetta* of Antioqua, but greatly exceeds the type in size, and is very much darker and much less rufous.

Mazama fuscata sp. nov.

Type, No. 34267, ♂ ad., Rio de Oro, Manavi, Ecuador; altitude, near sea-level.

Size large; coloration blackish brown; hair on back of neck reversed. Similar to *M. gualea* but coloration much darker and size larger. Upperparts blackish brown darker, almost black, over the whole dorsal area, browner on the sides where the hairs are finely vermiculated with rufous near the tips; belly nearly drab brown, but little lighter than the flanks, with a faint rufous suffusion; inguinal region clear white, the white extending as a broad band down the leg two thirds of the distance to the hock; interramial space and throat whitish, with a brownish band across the former; upper lip faintly edged with whitish; sides of neck cinnamon drab; legs in front like the body, posteriorly pale cinnamon rufous; ears dark brown, like the top of the head; tail very short, dark brown above, white below.

In the adult male type the pelage is thin and short; in the young female topotype it is much longer and thicker, and the rufous vermiculation on the tips of the hairs much stronger.

Represented by the type, an old male, and a young female topotype.

Skull, male type, total length, 210; condylobasal length, 200; occipitonasal length,— (nasals imperfect); preorbital length, 105; zygomatic breadth, 96; orbital breadth, 94; interorbital breadth, 56; occipital breadth, 64; breadth of braincase, 61.5; maxillary toothrow, 65; m^{1-3}, 29. Ratio of preorbital length to condylobasal length, 52.2%. Length of antlers from burr, 66; breadth of burr, 19; length of pedicel (inside), 11.

M. fuscata differs from *M. gualea* in much darker coloration and much larger size. *M. fuscata* is from the tropical coast-belt, *M. gualea* from the interior at altitudes of 6000 to 12,000 feet. They are probably representative forms of the same species. Neither of these forms is very closely related to *M. zetta,* judging by present material. In size *M. fuscata* approaches typical *M. americana* of the Guianas.

Mazama zamora sp. nov.

Type (and only specimen), No. 36581, ♀ ad., Zamora (altitude 2000 feet), southeastern Ecuador, Oct. 22, 1913; W. B. Richardson.

Hairs of back of neck not reversed. Bright yellowish red, redder over the middle region of the back, paler on the sides and on the ventral surface; nape and top of the head dusky; the tuft of long hairs on the front of the head mixed blackish and red; sides of interorbital region rufous; facial region blackish brown; a small white spot on each side of the rhinarium; ears blackish brown; chin and a median stripe on the lower throat white; upper throat buffy white, with a dusky brown spot on each side opposite the angle of the mouth, nearly meeting in the midline; color of the legs nearly uniform with the ventral surface; inguinal region and inside of thighs white; tail above like the back, white below.

Collector's measurements, total length, 1370 mm.; tail vertebræ, 80. Skull (teeth much worn), total length, 204; condylobasal length, 193; occipitonasal length, 174; preorbital length, 104; zygomatic breadth, 87; orbital breadth, 87; interorbital breadth, 40.6; occipital breadth, 61.5; breadth of braincase, 61; nasals, 64×22; maxillary toothrow, 65; m^{1-3}, 30.

In bulk *M. zamora* is about twice the size of *M. rufina,* as shown by perfectly comparable skulls (old females), and the two forms also differ greatly in color, *zamora* being light red and *rufina* dark red, and much blacker on the head, nape, ears, throat and limbs. The condylobasal length of the skull in *rufina* is 148 mm., in *zamora* 193; zygomatic breadth, respectively, 71 and 87; length of the maxillary toothrow, 49 and 65.

The red brockets of Peru, referred by Tschudi to *Cervus rufus*, doubtless include forms subspecifically separable from any of those recognized in the present paper, but there is at this writing no material available for their elucidation.

Brown Brockets.

Mazama simplicicornis (*Illiger*).

Cervus simplicicornis Illiger, Abhandl, d. k. Akad. Wissen. zu Berlin, III, 1811 (1815), p. 108 (nom. nud.), p. 117 = *Gouazoubira* Azara, ex Paraguay.

Mazama bira Rafinesque, Amer. Monthly Mag., I, p. 363, Sept., 1817 = *Gouazoubira* Azara.

Represented by an adult male (teeth much worn) from Rio Negro (near Asuncion), Paraguay, collected on the Roosevelt Expedition to South America, November 14, 1913, by Leo E. Miller. This specimen can be taken, geographically at least, as typically representing the species.

General color of the upperparts dull gray brown; no white facial markings; upper surface of tail and adjoining parts of back and buttocks yellowish rufous; digits and posterior face of limbs pale yellowish rufous; front of limbs dark brown, darker than upperparts of body; chin, throat, breast and most of the ventral surface washed with buff.

Collector's measurements, total length, 1200 mm.; tail vertebræ, 100; hind foot, 60; ear, 140. Skull, total length, 195; occipitonasal length, 163; condylobasal length, 183; zygomatic breadth, 86; interorbital breadth, 46.5; occipital breadth, 61; breadth of braincase, 58; maxillary toothrow, 54; m^{1-3}, 32. The premaxillaries do not reach the nasals, the space between them being 6 mm. The antler forms a cylindrical tapering spike, 133 mm. long from burr; diameter at base, 12; diameter of burr, 23.3; length of pedicel (inside), 12.

Mazama murelia sp. nov.

Type, No. 33906, ♀ juv., La Murelia (Rio Bodoquera), Caquetá, Colombia, altitude 600 feet, July 13, 1912; Leo E. Miller.

Upperparts drab gray, darker along middle of back, finely vermiculated with light buff and dusky; whole top of head blackish brown; broad dark eyering; a faint band of dingy grayish buff, both above and below the eye; no white eyespot; a small whitish spot on upper lip bordering the rhinarium; ears externally dark brown like top of head, edged basally with whitish; tail above dark brown like the midline of the back, the edges slightly mixed with fulvous, underside white; underparts dull white with a wash of pale drab, darker laterally and on the middle of the breast; limbs drab gray in front and on the sides, buffy white posteriorly.

Field measurements, total length, 980 mm.; tail vertebræ, 100.

Represented by a young female, in which the molars are fully developed but not worn, and the anterior milk premolars and canines still in place. Skull, total length, 174; condylobasal length, 163; occipitonasal length, 150; preorbital length, 88; zygomatic breadth, 74; orbital breadth, 74; interorbital breadth, 37.5; occipital breadth, 48; breadth of braincase, 63; nasals, 46 × 19; maxillary toothrow, 54; m^{1-3}, 24.

This specimen in coloration resembles, in a general way, a specimen of *M. simplicicornis* from Paraguay, but the upperparts are darker and lack wholly the broad band of cinnamon brown on the buttocks and sides of the tail, and the strong fulvous wash of the lower parts, while the dark drab color occupies three fourths of the circumference of the limbs instead of being restricted to a narrow band down the front. While the available material of the two forms is too limited for a satisfactory comparison, it is evident that the Murelia specimen represents a form strongly differentiated from typical *simplicicornis*.

Mazama tschudii (*Wagner*).

Cervus nemorivagus Tschudi, Fauna Peruana, I, 1844, p. 240.

Cervus tschudii Wagner, Schreber's Säug., Suppl., V, 1855, p. 386 (name in the text of p. 387). Based on the above.

This is doubtless a member of the *M. simplicicornis* group, of which I have as yet seen no Peruvian specimens. Judging by Tschudi's description it differs very appreciably in color from typical *simplicicornis*, and is also larger. It is quite probable that several forms of this type occur in Peru, in which case it will fall to their describer to fix the type locality for *tschudii*. According to Tschudi, deer of this general type range in Peru from sea-level to 16,000 feet.

Mazama nemorivagus (*F. Cuvier*).

Cervus nemorivagus F. Cuvier, Diction. Sci. Nat., VII, 1817, p. 485 (part, the Cayenne specimens only).

Mazama americana Osgood, Field Mus. Nat. Hist., Zoöl., X, p. 43, footnote, 1912 = *Cervus nemorivagus* F. Cuvier.

Type locality, Cayenne.

The name *Cervus nemorivagus* has been usually employed as a blanket name for all the brown brockets of South America. It is evident, from the author's own statement, that his *Cervus rufus* and *Cervus nemorivagus* were both based primarily on specimens in the Paris Museum from Cayenne, collected by M. Piteau.[1] It is therefore quite unimportant that he believed the Gouzoubira of Azara to be the same species and compiled his account in part from Azara.

I refer to this small species three specimens collected at Tumatumari, northern British Guiana, by Leo E. Miller in August, 1913. They are an adult female, a young female (just breaking through the alveolus), and a semi-adult male. The female (with the teeth considerably worn) may be described as follows:

Pelage long, coarse and soft; hairs of the nape not reversed. Upperparts grizzled pale fulvous gray, fading toward the ventral area, darkening to a broad median dorsal band of yellowish brown; hairs of the back ochraceous apically, narrowly banded near the tip with blackish; midventral area white, tinged with yellowish laterally, from chin to base of tail; limbs dusky externally, ochraceous buff internally; whole top of head dark brown, the long hairs of the crown more or less tipped with pale rufous; a supraorbital band of pale ochraceous from front of orbital region to side of crown; no white eyespot, but a small whitish area on either side of the rhinarium, and a whitish median spot above it; tail above like the back, white below; ears externally dark brown, scantily haired externally, nearly naked internally.

Field measurements: Total length, ♂ juv. 1020 mm., ♀ ad. 1160 (? = 1060); tail vertebræ, ♂ 150, ♀ 120.

The skulls measure: Total length, ♂ 150, ♀ 189; condylobasal length, ♂ 159, ♀ 176.5; occipitonasal length, 150, ♀ 162.5; preorbital length, ♂ 83, ♀ 95.6; zygomatic breadth, ♂ 75, ♀ 76; orbital breadth, ♂ 75, ♀ 76; interorbital breadth, ♂ 39, ♀ 35; occipital breadth, ♂ 53.2, ♀ 54; breadth of braincase, ♂ 55, ♀ 56.4; nasals, ♂ 51 × 16, ♀ 51 × 15.4; maxillary toothrow, ♂ 50.5, ♀ 50.5; m^{1-3}, ♂ 23, ♀ 23. The antlers of the male are smooth, slender spikes, 55 mm. long from burr.

Preorbital portion of skull short, as in the *M. cita* group; about 50% of the condylobasal length.

Mazama superciliaris (*Gray*).

Coassus superciliaris Gray, Knowsley's Menagerie, pl. xlviii, 1850 (Jan. 24, 1852); name on the plate but not given in the text.— Gray, Proc. Zool. Soc. London, 1850, p. 242, pl. xxv (animal), pl. xxvii, fig. 4 (front view of head). Para, Brazil. External characters only; Gray, Cat. Mamm. Brit. Mus., 1852, p. 239; Cat. Ruminant Mamm. Brit. Mus., 1872, p. 92, part; Hand-List Edentate, Thick-skinned and Ruminant Mamm. Brit. Mus., 1873, p. 161. "S. America."

The type locality, as given by Gray, is Para, Brazil, from which locality I have seen no specimens, nor from elsewhere in east-central Brazil. According to Gray's plates and description, this should be a well marked form, particularly characterized by the white band over the eyes.

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[1] *Cf.* G. Cuvier, Ossem, foss., ed. 2, IV, p. 55; Pucheran, Arch. du Mus., VI, 1852, p. 474; Brooke, Proc. Zool Soc. London, 1878, 925.

It has been recognized as a "good species" by most subsequent compilers and revisers, including Sir Victor Brooke, by whom it is listed, however, without comment.

Mazama cita cita *Osgood.*

Mazama americana citus[1] Osgood, Field Mus. Nat. Hist., Zoöl., X, p. 43, Jan. 10, 1912.

Type locality, El Panorama, Rio Aurare, eastern shore of Lake Maracaibo, Venezuela.

This species, as noted by the author, differs very considerably in coloration from *M. nemorivaga* of the Guianas, and also in the heavier dentition, although the measurements given do not indicate larger general size. The color differences are much more significant than the difference in size.

Osgood (*l. c.*) gives the external measurements of the type (male) and of a female paratype as follows: "Total length 1,090, 1,060 mm.; tail vertebræ 105, 115; hind foot 278, 280; circumference of chest 600, 560; neck, 240, 218; shoulder to hip 550, 570; height at shoulder 545, 587." Skulls of the same specimens: "Greatest length, 189, 185; zygomatic breadth 80.6, 81.8;....breadth of braincase 57.4, 55; maxillary toothrow 61.5, 58.8...."

My own measurements of the female paratype skull (Field Mus. No. 18778, Empalado Savanna, Venezuela) are as follows: Total length, 184.5; condylobasal length, 177, occipitonasal length, 160; preorbital length, 92; zygomatic breadth, 81; orbital breadth, 76; interorbital breadth, 40.6; occipital breadth, 55; breadth of braincase, 54.5; nasals, 58.5 × 29.5; maxillary toothrow, 58; m^{1-3}, 33.5. The specimen is a young female with the teeth fully developed but unworn.

Mazama cita sanctæmartæ subsp. nov.

Mazama nemorivaga Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 429, Nov. 28, 1904.

Type, No. 14640, ♂ ad., near Bonda, Santa Marta, Colombia, Dec. 20, 1898, H. H. Smith. Coll.

Size medium. Pelage short and fine. Hairs on nape not reversed. Upper parts pale ochraceous buff, deeper and more ochraceous on the median line, paler and lighter on the flanks, grizzled faintly with blackish (most strongly medially), the hairs being barred near the tip with dusky; underparts white from chin to base of tail, faintly washed on the breast and laterally with a tinge of buff; fore limbs externally like the flanks but with a faint grayish drab tone, internally like the belly; hind

[1] As *Mazama* is usually treated as feminine, it seems preferable to write *cita* instead of *citus*.

limbs like the flanks with a tone of grayish drab, the white of the underparts continued as a narrowing white band as far as the hock; tail above like the back, beneath white; top of head wood brown, sides of head pale drab gray, passing gradually into the white of the throat; usually a small white or whitish spot over the anterior corner of the eye, often absent (or only a trace, as in the type); rest of the space between the orbital region and the long hair of the crown reddish ochraceous; a conspicuous white lip spot on each side of the nose; ears clothed externally with very short wood brown hair, bordered with white, especially basally.

Collector's measurements: "Length 3 feet 8 inches [1117 mm.]; girth, 2 feet $1\frac{3}{4}$ inches [654 mm.]" Skull (type), total length, 183 mm.; condylobasal length, 181; occipitonasal length, 165; preorbital length, 93.5; zygomatic breadth, 79; interorbital breadth, 45; orbital breadth, 81; breadth of braincase, 54; occipital breadth, 79: nasals, 52 × 27.5; maxillary toothrow, 59 (maximum in a series of 12 skulls); antlers, length from burr 104, diameter at burr 15, length of pedicel, 8. (See next page for table of measurements.)

The variation in color is not very great and appears to be correlated largely with season; March and April specimens are more ochraceous than November and December examples, and the pelage is fuller and longer, and the hairs of the crown more strongly tipped with rufous. The white eyespot is present in most of the specimens, in some large and conspicuous, in others reduced to a mere trace or wholly wanting. The young in spotted coat are yellowish ochraceous above with the white spots rather dull and not sharply defined.

Mazama cita sanctæmartæ belongs to the *M. nemorivaga* group, but differs from typical *nemorivaga* in larger size and more fulvous coloration. It is evidently closely related to *Mazama cita* Osgood, from which it seems to be only subspecifically separable, differing from *cita* in smaller size and somewhat in coloration.

Mazama pandora *Merriam.*

Mazama pandora Merriam, Proc. Biol. Soc. Washington, XIV, p. 105, July 19, 1901.

This is one of the palest and smallest species of the brown brocket group, it being paler and somewhat smaller than even *M. nemorivaga*. The external measurements given by Dr. Merriam for the male type are, total length, 1125 mm.; tail vertebræ, 140; hind foot, 273; height at shoulders, 572. The principal measurements of the skull of the male type, as given by Dr. Merriam, are as follows: Basal length, 163; occipitonasal length, 157; zygomatic breadth, 82; orbital breadth, 73.5; interorbital breadth, 44; maxillary toothrow, 50; antler, length from burr, 113. My own measurements of the adult female skull (paratype) from Apazote, Campeche, Mexico (U. S. Nat. Mus. No. 108287) are: Total length, 181; condylobasal length, *Measurements of 12 Adult Skulls of Mazama cita sanctæmartæ.*

Cat. No.	Locality	Sex	Total length	Condylobasal length	Occipitonasal length	Preorbital length	Zygomatic breadth	Orbital breadth	Interorbital breadth	Occipital breadth	Breadth of braincase	Length of nasals	Breadth of nasals	Maxillary toothrow	Length of M^{1-3}	Ratio of condylobasal to preorbical length
14865	Bonda, Santa Marta, Colombia	♂	183	173	163	90	82	83	44	55	56	58	23	57	26	52
14640	" " " "	♂	185	181	156	93.5	79	81	45	53	54	52	27.5	58	26	51.7
14645	" " " "	♂	182	173	159	89	77	81	44	54	57	57	24	55	25	51.4
14643	" " " "	♂	186	175	165	91	79	81.5	44	55	60	59	28.3	56	25	52
23478	" " " "	♂	180	167	166	83	80	85	45	54	57	53.5	26	55	25	50.4
14642	" " " "	♀	187	180	165	94	79	81	42	54.5	55	61	23	54.5	23.6	52.2
14646	" " " "	♀	178	165	157	86	76	75	40.5	50	51.4	58	24	53	24	52.1
14638	" " " "	♀	175	166	153	83	79	78.5	38.5	51.6	54	52	23.5	56	26.3	50
14864	" " " "	♀	176	172	151	90	78	78	43	54	55	50	23.5	54.5	24	52.3
23476	" " " "	♀	180	170	160	89.5	75	72	39	55	56	58	24.3	57	25.5	52.4
23479	" " " "	♀	180	172	155	90.5	77.5	80	40	54	56.5	55	21.3	55	25.5	52.6
23481	" " " "	♀	180	167	153	88	76.3	75	38	52	56	49	19	53	23	52.7
	Average	....	181	171.8	158.3	89	78.2	79.4	42.8	51.8	55.7	56	24	55.3	24.9	51
	Minimum	....	175	165	151	83	75	72	38	50	51.4	49	19	53	23	50
	Maximum	....	187	181	166	93.5	82	85	45	55	60	61	28.3	58	26.3	52.7

171; occipitonasal length, 160; preorbital length, 86; zygomatic breadth, 79; orbital breadth, 78; interorbital breadth, 38; occipital breadth, 60; breadth of braincase, 55.5; nasals, 56 × 15; maxillary toothrow, 53; m^{1-3}, 29.5. Ratio of preorbital to condylobasal length, 53.7.

Known at present only from original specimens, respectively from the two Tunkas, Yucatan, and Apazote, Campeche.

This is the only species of the brown group known from north of Venezuela, as the specimen recorded by me from Nicaragua (this Bulletin, XXVIII, p. 95, April 30, 1910) proves on reëxamination to belong to a small species of *Odocoileus*, probably *O. truei*.

Comparative Measurements of Skulls of Species and Subspecies of Mazama.

	Number of specimens	Total length	Condylobasal length	Preorbital length	Zygomatic breadth	Occipital breadth	Breadth of braincase	Maxillary toothrow	Ratio of preorbital to condylobasal length
M. trinitatis	1 ♂, 1 ♀	215	206.5	109.5	96	63.5	61.6	65.3	53%
M. americana americana	1 ♀	235	—	124	—	—	—	68	52.6
M. americana tumatumari	1 ♀	234	222	124	92	72.5	67	73.5	55.9
M. americana juruana	1 ♀	228	214	116	100	65	65	61.5	54.2
M. rufa rufa	3 ♂, 2 ♀	211	202	108	91.2	59	61	60.7	54.8
	Min.	206	193	102	90	57	59	59	52.6
	Max.	217	209	114	93	62	62.5	62.5	55.6
M. rufa jucunda	1 ♂	—	178	—	88	—	—	61	—
M. brincenii	1 ♀	159	—	—	70	—	—	51	—
M. rufina	1 ♀	162	151	77	72	55.5	51	48	53
M. zamora	1 ♀	204	193	104	87	61.5	61	65	51
M. sartorii sartorii	1 ♀	174	160	83.5	80	53.7	56	51.5	52.2
M. sartorii cerasina	1 ♂, 4 ♀	185	174	88.6	80.7	51	57.1	55.2	50.7
	Min.	180	170	85	77	48.5	56	54	50
	Max.	189	180	91	86	54	58	58	52
M. sartorii reparticia	1 ♂, 3 ♀	193	186	94	82.4	55.6	58	58.6	51.1
	Min.	188	176	89	81	53	55	57	50
	Max.	202	196	100	83.6	59.3	60	60	52.2
M. zetta — Type and topotype	1 ♀, 1 ♀	—	188.5	—	—	—	—	60.5	—
M. zetta — Gallera specimen	1 ♀	200	188	100	88	60.5	60	60	50
M. gualea	1 ♀	195	185	96.5	86.5	65	60	58	52.2
M. fuscata	1 ♂	210	200	105	96	64	61.5	65	52.5
M. simplicicornis	1 ♂	195	183	99	86	61	58	54	54.1
M. murelia	1 ♀	174	163	88	74	—	63	54	54
M. nemorivaga	1 ♀	188	178	95.5	76	53.2	56	50.5	53.7
M. cita cita	1 ♀	184.5	177	92	81	55	54.5	58.5	50
M. c. sanctæ-martæ	5 ♂, 7 ♀	181	171.8	89	78.2	51.8	55.7	55.3	51
	Min.	175	165	83	75	50	51.4	53	50
	Max.	187	181	93.5	82	55	60	58	52.7
M. pandora	1 ♀	181	171	86	79	60	55.5	53	53.7

59,57,62C(75.9)

Article XIX.— LIST OF THE CARABIDÆ OF FLORIDA.[1]

By Charles W. Leng.

In the Proceedings of the American Philosophical Society, February 1, 1878, appeared the 'Coleoptera of Florida' by H. G. Hubbard and E. A. Schwarz, with descriptions by John L. Leconte; 1457 species were therein enumerated. During the thirty-seven years which have elapsed since that famous paper was printed the number of known species has become about doubled, making a new list desirable.

The materials available include (1.) an annotated copy of the list above mentioned loaned by Mrs. Annie Trumbull Slosson, in which the results of many winter trips to Florida have been carefully recorded. Her collections were made principally at Jacksonville, Ormond, Lake Worth, De Funiak Springs, Tarpon Springs, Pensacola, Suwannee, Biscayne Bay, Belleair, Punta Gorda, Atlantic Beach, Altamonte, Enterprise, and Naples, always from January to March. The identifications were commonly made by Mr. Charles Liebeck, though frequently in particular groups by the authorities in such. (2.) An annotated list loaned by Mr. Schwarz, in which all additional data, either from printed matter or other communications were noted. Many of Mrs. Slosson's records are here duplicated, all the printed and manuscript lists by Castle and Laurent, Hamilton, Johnson and others are included, as well as stray notes from taxonomic papers, and corrections by Mr. Schwarz of the original list. (3.) The results of several trips to Florida by members of the staff of the American Museum of Natural History and of the New York Entomological Society, including those of Mr. Gustav Beyer to Key Largo; Dr. Frank E. Lutz, alone or with Mr. William T. Davis and the writer to Jacksonville, Lakeland, Titusville, Miami, the Florida Keys, Punta Gorda, Fort Myers and Newberry; Mr. Davis and the late John A. Grossbeck to Marco, Everglade, Deep Lake, Allen River, and Lake Okeechobee; Mr. Davis and Mr. Chas. E. Sleight to Ortega, La Grange, Big Pine Key and Key West; Mr. Andrew J. Mutchler and Mr. Frank E. Watson to Gainesville, Monticello, Crestview, De Funiak Springs, and Pensacola. (4.) A number of records have been obtained from

[1] The following new names are proposed in this paper, viz.
Scaphinotus elevatus var. *floridanus* n. var.
Phlœoxena signata var. *nigripennis* n. var.
Chlœnius niger var. *ludovicianus* n. var.
Selenophorus chokoloskei n. sp.
Ferestria n. gen. (type *Pterostichus lœvipennis* Lec.).

other travelers in Florida (Prof. J. Chester Bradley, Mr. J. R. Watson of the Florida Agricultural Experiment Station, Mr. Charles Dury and Mr. W. S. Blatchley especially), and from the writer's own collection, which includes the extensive material collected by Mr. W. S. Genung at Stephensville in Taylor County and at Sebastian and Paola, and that collected for Mr. Geo. W. J. Angell by Charles L. Brownell at Cape Sable and Enterprise, where sifting the lake shore debris in late fall and winter gave good results.

Notwithstanding the considerable amount of material thus included in making the new list, there are still many species included on doubtful or single records, and some instances in which the data given for captures contradict the previously recorded distribution of the species. These doubtful cases have been eliminated as far as possible, and in this connection the very careful collecting of Mr. H. P. Löding, of Mobile, Ala., has been used to check the Florida list. It appears to be a fact that the distribution of some species is actually very limited or "patchy" as Mr. P. H. Rolffs expressed it in speaking of a similar condition in the distribution of plants, so that a solitary record may well fail of repetition unless the exact locality and date is also repeated, and additions to the list may reasonably be expected as other localities are examined and other methods of collecting are applied. For Carabidæ, the sunken bottles, baited with molasses, so much used by Mr. Davis, are strongly to be recommended in this connection.

During 1914, volumes IV and V of the 'Memoirs of the Coleoptera' by Col. Thomas L. Casey, appeared and since they dealt largely with the Carabidæ, many additional records were thus obtained. If all the new names proposed in these papers were added, the list would be enlarged, particularly in the number of species peculiar to Florida; but this course has not seemed justifiable because the descriptions show the names in many instances to be intended to replace those now in use (and already cited) and their treatment as additions would therefore be misleading. Such names are, however, mentioned in their appropriate place, leaving the choice between using them and the older names for future investigation.

To all of the friends named above and to Dr. Leland O. Howard, Chief of the U. S. Bureau of Entomology, for permission to use the records accumulated by Mr. Schwarz, my thanks for assistance in various ways are due and heartily tendered.

As to the comparison of the species of Carabidæ now known to inhabit Florida with those of other regions, it may be said that nearly all are of the same genera and species as those of the more northern states, about one third, however, extending only into the Gulf Strip; about ten per cent. of the species and varieties are peculiar to Florida. Of that ten per cent. not quite half occur also in Cuba, and one rather feeble variety occurs also in Yucatan. Many of the forms comprising the ten per cent. peculiar to Florida might be considered as merely varieties of northern species; the following are however remarkably distinct species, viz: *Cicindela striga*, *Euproctus trivittata*, *Onota floridana*, *Chlænius maxillosus*, *Lebia lecta*. Their existence, and that of a few species which may have spread from Florida into adjoining states in recent times, might be explained by the assumption of ancient coral islets where southern Florida now stands which have since become joined to the American mainland by an advancing peninsula of coral, shell-rock and sand, bringing with it an insect population that could so overwhelm the scanty fauna of such an islet that only a feeble remnant would be traceable. That the great bulk of Florida Carabidæ are identical with those of the rest of the United States may be shown as follows: 284[1] species and varieties of Carabidæ are enumerated, of which 31 are not found elsewhere in the United States, and 71 more are found only in the extreme southern states, Georgia, Alabama, Louisiana and Texas. In other words, over one third of the species are new to the collector from the northern States, and it is this fact that has made the fauna so interesting. There remain 182 species known from the regions north and northwest of Florida, some extending to District of Columbia, others to New York, and a few even to Canada. Of these some are northern species whose southern limit of distribution is reached in Florida, but most are Sonoran species whose range extends variously northward.

The relation with Cuba is evidenced by the following cases of specific identity: *Calosoma splendidum*, a Cuban species found only occasionally at Key West; *Tetracha carolina*, a member of a tribe greatly developed in the tropics, which has a range northward to Washington, D. C.; *Cicindela marginata*, a species of marshy shores, from Cuba to Maine, along the Atlantic Coast; *Cicindela trifasciata*, a species of similar shore habits, occurring all around the Gulf of Mexico and in several West Indian islands, extending in the United States northward possibly to North Carolina; *Bembidium affine*, a member of a difficult group taxonomically; *Morio monilicornis*, found under bark of dead pines in Cuba, Florida and north to North Carolina; *Chlænius perplexus*, a tropical species found in moist shore situations in Cuba, Florida and Central America; *Chlænius niger*, a species of similar habit found from Newfoundland to Florida, Cuba and Louisiana, perhaps

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[1] This number may be compared with 304 recorded from District of Columbia, 357 from New Jersey, and 366 from Indiana, to indicate the comparative scarcity of the Carabidæ in Florida, especially in the genera *Bembidium*, *Platynus*, *Pterostichus*, *Amara* and *Harpalus*, so fully represented in Transition regions. The comparison may be made with the additional condition of the smaller area included in each case in mind; an area equal to that of Florida surrounding the District of Columbia would doubtless yield more than 304 species.

the most remarkable distribution shown by the list; *Oodes amaroides*, a species of similar habit found in Cuba, and the United States northward to New York; *Plochionus pallens*, a species of somewhat cosmopolitan distribution; *Lebia cyanea*, a species found on plants in Cuba and Florida; and *Leptotrachelus dorsalis*, a species found on plants in Cuba, Florida, and northward to New York.

The Cuban relation is also shown by the fact that of all the genera of Carabidæ known from Cuba, 90% are also Floridian genera, and while the species by which the genera are represented differ in the two regions, the difference is often not great, and further study may, in *Selenophorus* for instance, add to the twelve cases of specific identity already known. Dr. Leconte's statement that "a remarkable feature in the geographical distribution. . . .is the comparatively small number of species common to Florida and the Antilles," will require some modification, at least as far as Cuba and the family Carabidæ is concerned.

As to the difference between north and south Florida, it may be said that the marked difference in the trees, as stated by John K. Small ('Florida Trees,' 1913, brought to my attention by Mr. Davis), is not clearly paralleled in the Carabidæ. The difference is exhibited by the increased failure in southern Florida of the species of boreal genera, rather than by any considerable number of species confined to that part of the state. The factors governing the distribution of the Carabidæ are apparently more complicated than those operative in the plant world, particularly in respect of a variable capacity for adaptation to changes in temperature and moisture.

Dates of capture and environmental facts have been inserted as far as known. While some species may be found at all seasons, others are evidently more limited. Mr. Schwarz wrote long ago "the dry season, which corresponds with the winter months, causes a disappearance of insects in Florida almost as complete as in the north," and the experiences of Mr. Davis at Everglade, where *Tetracha* did not appear until after his departure in April, and of Mr. Brownell at Enterprise, where the Carabidæ were sifted from the debris on the shores of Lake Monroe in October, November and December, amply justify the importance of dates even in Florida. As to environment, such extreme cases as *Onota floridana* being confined to Palmetto are rare in Carabidæ, but there are no species to which the local environment is not a factor of prime importance.

After this paper was set in type, I learned that the last collections made by H. K. Morrison in Florida, which passed into the Angell collection labelled Key West, were in part made at Tampa. Some such specimens are also in my own collection. Key West records based thereon are therefore questionable.

Subfamily CICINDELINÆ.

Tribe Megacephalini.

Tetracha carolina (*Linné*). Enterprise, Cedar Keys, (Schwarz); Lake City (Agl. Exp. Sta.); Jacksonville (Genung); May, June, August. Common on mud-flats, hiding by day; also attracted by light. Extends northward to Virginia, westward to California, without modification; also southward to South America, but splitting south of the Rio Grande into several slightly differentiated races which have received names. In the West Indies the species *occidentalis* Klug, from Cuba, is considered identical by most authorities, and closely allied forms are known from Porto Rico, Haiti, St. Thomas and St. Croix.

Tetracha carolina subsp. **chevrolati** *Chaudoir*. Everglade, Lee Co. A few specimens taken in May, June and July by the family of Mr. Geo. W. Storter were forwarded to Mr. Wm. T. Davis, who had not found any species of the genus during his sojourn at this locality in April, indicating clearly the season for this genus. The identification was made by Dr. Walther Horn of Berlin from specimens sent to him by Mr. E. D. Harris; the subspecies differing from typical *carolina* mainly in the color, which is a deeper shade of blue; its occurrence is of special interest because it has previously been known from Yucatan.

Tetracha virginica (*Linné*). Enterprise, Cedar Keys, Kissimmee, Haw Creek (Schwarz); Key Largo (Harris Coll.); Everglade (Davis Coll.); Punta Gorda (Davis); May, June, July. The Punta Gorda record is based on an elytron, found November 16; no living specimens were found at the time. This species is found with *carolina* and has a similar but less extended range; northward to Virginia and Ohio (Dury), or even to Long Island, if the single specimen found at Central Park, L. I., by Mr. Davis can be considered as establishing its occurrence there, westward to Colorado. In the West Indies, *T. acutipennis* Dejean, of Cuba and Haiti, is closely related.

The genus *Tetracha* is represented by numerous species in Central and South America and by a few in Africa and Australia. In the old world, it has not extended north of the Mediterranean region.

Tribe Cicindelini.

Cicindela scutellaris *Say*, var. **nigrior** *Schaupp*. Crestview, Oct. 15–16, 1914 (Mutchler and Watson). This variety is known from Alabama, where it has been found by H. P. Löding, but was found for the first time in

Florida in 1914. It is interesting to note that, notwithstanding the close relation to var. *unicolor* and the number of localities in which the latter has been found, it is apparently only at Crestview that the two varieties have been found together.

Cicindela scutellaris *Say* var. **unicolor** *Dejean.* De Funiak Springs, Oct. 17–19 (M & W), Crescent City, Lake City, Pensacola, Oct. 11–14, Suwannee Springs (Schwarz); Tampa (Engelhardt); Enterprise (Brownell); Ormond (Mrs. Slosson); March, April (Blatchley); Taylor Co., (Genung); Lakeland(Davis); Key West? (Angell Coll.); La Grange (Davis); Crestview, Oct. 15–16 (M & W); February, March, September, October, November. Florida specimens, especially those from Key West, have a peculiar color, more bluish than northern forms, somewhat similar to that of var. *carolina* Harris. The variety *unicolor* extends northward to Georgia, westward to Texas. The species as a whole extends northward to Massachusetts, Canada and Manitoba and westward to the Rocky Mountains.

Cicindela tranquebarica *Herbst.* De Funiak Springs, Oct. 17 (Mutchler & Watson). Specimens labelled "Fla." in Harris Coll.; Suwannee, January–March (Slosson Coll.). Florida specimens resemble var. *vulgaris-minor* Harris but are too few in number to permit of exclusive association with that race. The species is abundant in the pine woods of Louisiana, occurs in northeast Alabama but not near Mobile (Löding) and extends northward to Quebec and Newfoundland, westward to California. It is much modified, however, in the northern and western parts of its range, where it has received varietal names.

Cicindela hirticollis *Say.* Sea shore, as far as Key West (Schwarz); St. George's Island, February (Schwarz); "Fla." (Harris Coll.). Not found recently by collectors, but abundant on Bay Shore, Baldwin Co., Ala. (Löding). Extends northward to Quebec (Beaulne, Le Nat. Can. 1914, p. 111), westward to California.

Cicindela punctulata *Fabricius.* St. Augustine (Schwarz), Lake City (Agl. Exp. Sta.); Taylor Co. (Genung); Enterprise (Brownell); Lakeland, Everglade, and La Belle (Davis); La Grange, and Ortega (Davis & Sleight); Jacksonville; Gainesville, September, October, Camden, June 28, Crestview, Oct. 15–16, Monticello, Oct. 4–8. Common, appears about the beginning of May, actual dates from April 27 to Nov. 6. Some Florida specimens differ from those found northward in the more brassy color and smoother thorax, but much variation exists in these respects as well as in the completeness of the markings. Extends northward to Quebec (Beaulne, Le Nat. Can. 1914, p. 123), westward to Arizona.

Cicindela trifasciata *Fabricius* (= *tortuosa* Dejean). Lake Worth, Pensacola, Key West, Biscayne Bay, St. Augustine (Schwarz); Chokoloskee and Miami (Harris Coll.); Suwannee (Slosson Coll.); Enterprise (Brownell); Fort Myers, Everglade, Lakeland, Okeechobee, Deep Lake, Punta Gorda and La Belle (Davis); Pablo Beach, Big Pine Key, La Grange (Davis & Sleight); Gainesville, September, October, Crestview, Oct. 15–16. Everywhere, the most abundant species in Florida, often seen in immense numbers; Feb. 27 to Nov. 27; found on beaches, river banks, etc. Extends northward to Georgia, westward to California, where it is scarcely modified, and southward to West Indian islands.

Cicindela dorsalis *Say*, var. **media** *Leconte*. Common on sea beach, Key West, Biscayne Bay, Lake Worth, St. Augustine (Schwarz); Miami, Nov. 23 (Davis); Daytona Beach, Jacksonville, July; Jupiter (Harris Coll.); Useppa Island (Davis Coll.); earliest date recorded is April 4; latest Nov. 23, Miami (Sleight). Not found in Alabama (Löding). Var. *saulcyi* Guérin, with elytra entirely white is less abundant; Key West, Gaspar Key (Schwarz); Marco, May (Harris Coll.), Long Boat Key, Sarasota, Aug. 14 (Bradley); Cape Sable (Brownell); Mobile and Baldwin Co., Ala. (Löding). *C. dorsalis*, sensibly modified, extends northward to Rhode Island; var. *media*, including immaculate forms, northward to Delaware; var. *saulcyi* appears to be confined to the shore of Gulf of Mexico, extending westward to Texas. It is noteworthy that no form of *dorsalis*, a species frequenting clean sandy beaches and avoiding the salt marshes, has yet been found in the West Indies.

Cicindela hamata *Brullé*. Cedar Keys, Punta Gorda (Schwarz); Marco (Harris Coll.); Punta Rassa, Marco (Davis); Long Boat Key, Sarasota, Aug. 14 (Bradley); Cape Sable (Angell Coll.); April 3, May, June. Confined to the shores of the Gulf of Mexico, extending westward to Texas; Mobile and Baldwin Co., Ala., June to October (Löding).

Cicindela marginata *Fabricius*. Common on the lagoon and ocean beach of the east coast, extending its range on the west coast at least to Marco. Lake Worth, Key West, Biscayne Bay, St. Augustine (Schwarz); Jacksonville, July, Big Pine Key, Miami (Davis & Sleight); Everglade, Useppa Island, Punta Rassa, Marco (Davis Coll.); April to November. Extends northward to Maine and occurs also in Cuba. Not found in Alabama (Löding).

Cicindela hirtilabris *Leconte*. St. Augustine, Crescent City (Schwarz); Taylor Co. (Genung); Cedar Keys (Harris Coll.); Bradentown, Aug. 15 (Bradley); Enterprise (Brownell); La Grange, Ortega (Davis & Sleight); June, October, November. A species peculiar to the open sandy places in the pine woods of Florida. Not found in Alabama (Löding).

Cicindela gratiosa *Guérin*. Pensacola, De Funiak Springs (Schwarz); "Fla." (Harris Coll.). Extends northward to Wilmington and Southern

Pines, N. C., also Mobile and Baldwin Co., Ala., June to October (Löding).

Cicindela severa *Laferté.* Punta Gorda (Schwarz); Cape Sable, May (Brownell); Key West. Occurs also in Alabama, shore of Mississippi Sound, June–August (Löding); Louisiana and Texas.

Cicindela striga *Leconte.* Lake Harney, Punta Gorda (Schwarz); "Fla." (Harris Coll., a specimen taken by Mrs. Slosson); Fort Myers, April 22 (Davis and Grossbeck); "very rare in May, nocturnal in habit" (Schwarz); Fort Myers, June, at light (Löding Coll.). Probably lives on marshy beaches. Peculiar to Florida.

Cicindela abdominalis *Fabricius.* Common in the pine woods. Enterprise, Cedar Keys, Pensacola, De Funiak Springs, Crescent City (Schwarz); Taylor Co. (Genung); Suwannee (Slosson Coll.); Enterprise (Brownell); March to November. Extends northward to Long Island, westward to Louisiana. Mobile and Baldwin, Ala., June–October (Löding).

Cicindela scabrosa *Schaupp.* Crescent City (Schwarz); Cedar Keys, June (Harris Coll.); Lakeland, August 16 (Bradley); Taylor Co. (Genung); Enterprise (Brownell); La Grange, Nov. 10–11 (Davis & Sleight). Occurs sometimes with *abdominalis,* of which it is usually regarded as a race peculiar to Florida. Not found in Alabama (Löding). Casey (Memoirs on the Coleoptera, IV, 1913) has described *C. abdominalis* ssp. *faceta* and *C. extenuata,* the first without locality, the second from Crescent City and possibly identical with those cited above as *scabrosa* from that locality. *C. faceta* Casey is certainly not Floridian. There is a difference between the specimens of *abdominalis* from Florida and those from New Jersey in maculation, those from Florida having rarely more than the apical lunule and one discal dot, while those from New Jersey have usually in addition two dots representing the middle band and a marginal elongate spot near apical third. Rarely (in New Jersey specimens) the humeral lunule is also represented by two dots, and it is probably such a specimen that Casey has described as ssp. *faceta,* a name which may be used for the New Jersey form in future, though many specimens from that region lack the humeral dots called for by the description and some are almost as nearly immaculate as the Floridian form. As stated by Casey, the *faceta* forms have also more of a violet lustre than those from Florida, and taken as a whole are sufficiently different to make it certain that *faceta* could not be Floridian.

In regard to *C. extenuata* Casey, it is to be feared that the brief description of *scabrosa* by Schaupp, repeated by the writer, has led to an absolute synonym. Casey, under the name *extenuata,* has described a form supposed to differ from *scabrosa* by its smaller size (7.5–8.5 mm. against 10.5 mm. given for *scabrosa*), by the foveæ of the subsutural line being non-metallic (not mentioned in *scabrosa* description), and by the conspicuous pronotal lateral vittæ of transverse white hairs (also unmentioned in *scabrosa* description). An examination of eighteen specimens of *scabrosa,* selected to show range of variation from a much larger number, shows a variation in size from 7.5 to 10 mm., none being quite as large as the measurement given by Schaupp; shows also the subsutural foveæ always non-metallic, and a great variation in pronotal pubescence, running from almost obsolete to the conspicuous vittæ described by Casey. The conclusion is inevitable that *extenuata* is a synonym of *scabrosa,* due to faulty description of the latter; the name selected being perhaps in allusion to the extenuating circumstances.

Cicindela repanda *Dejean.* "Fla." (Harris Coll.); "Fla." (Leng Coll.). This common species occurs in Georgia and Alabama (Mobile and Baldwin Co., bay shore and creek sides (Löding) and very commonly northward and westward over most of the United States and Canada; definite Floridian data lacking.

?**Cicindela sexguttata** *Fabricius.* "Fla." (Harris Coll.). The specimens were received from Schaupp Collection. Common in northern Alabama, one specimen from Mobile Co. (Löding).

?**Cicindela unipunctata** *Fabricius.* "Fla." (Harris Coll., Roberts Coll., Leng Coll.). The nearest locality Löindg has is Blount Mt. in northern Alabama.

?**Cicindela blanda** *Dejean.* This species has been found on the banks of Spring Creek in Georgia. Since Spring Creek is a branch of the Apalachicola River, which flows through northern Florida, it seems likely that *C. blanda* will be found, as soon as the banks of the river are visited in summer. It occurs also in Alabama at Oak Grove in June and July (Löding).

The following additional species which occur in southern Alabama have never been reported from Florida, viz: *cursitans,* Mt. Vernon, bank of Mobile River, June 14; *togata,* Coden, salt marsh shore of Mississippi Sound; *rufiventris,* Mobile, and Baldwin Co., May to August; *cumatilis,* Mobile Co. There is no foundation for including them, though it may be likely they do occur in northwest Florida.

Sub-family CARABINÆ.

Tribe Omophronini.

Omophron labiatum (*Fabricius*). Common at light and on grassy shores, where it is found by pouring water over the banks. Sand Point, Indian River, etc. (Schwarz); Lake Worth, Miami (Slosson Coll.); Lakeland, Fort Myers, Nov. 15, at light, Everglade, Lake Okeechobee (Davis); Enterprise (Brownell); Clearwater, etc.; March, April, June, November, December. Extends northward along Atlantic Coast to New Jersey, where it becomes rare; also Mobile Co., Ala., where Mr. Löding takes also *O. nitidum.*

Tribe Cychrini.

Scaphinotus elevatus var. **floridanus** n. var. A single specimen which passed from the Schaupp collection into that of Luetgens and then into the collection of the writer under the name of *elevatus*, formed the basis for crediting that species to Florida in Bull. Br. Ent. Soc. I, p. 34, and perhaps even for Roeschke's mention of northern Florida as the southern limit for that species. It differs, however, from *elevatus* in size and in the greatly thickened margin of the thorax and coarse punctures of the disk and may be described as follows:

Size and form similar to that of *S. elevatus*, variety *flammeus*, broader and shorter than in variety *tenebricosus;* color dark, almost black with faint bluish lustre. Thorax broader than long, with hind angles produced far over the elytra, and side margins elevated, but less so than in *elevatus*, the bead greatly thickened and the disk strongly punctate, the coarse moderately closely placed punctures arranged in two curved spaces on either side of a smooth central space (divided only by a deeply impressed median line) which broaden and unite a little in front of the base. Elytra similar to those of *elevatus* variety *flammeus*, broad and but slightly convex on disk, and with the side margin less elevated at humerus than in typical *elevatus*. In the male the tip of the first tarsal joint and the whole of the second, third and fourth joints beneath are spongy pubescent. Length, 21 mm. ♂. ♀ unknown.

The thoracic punctuation is similar to that of *S. shoemakeri*; but, although the present is a smaller insect, the punctate area is much greater and the punctures deeper; the sinuation of the elytral margin, characteristic of *shoemakeri* is not even faintly indicated.

A *Scaphinotus* believed to be the true *unicolor* Fab. is taken by Mr. Löding at Mt. Vernon, Ala. It lacks both the thickened thoracic bead and discal punctures characteristic of *floridanus.*

Tribe Carabini.

Carabus sylvosus *Say.* Ormond (Slosson Coll.), January or March. Occurs in Ontario, Massachusetts, New York, New Jersey, Pennsylvania, District of Columbia, West Virginia, Indiana; New York to Texas (Bull. Br. Ent. Soc.); Baldwin Co., Ala., one specimen (Löding). *C. vinctus* var. and *C. lecontei* Casey are reported from Alabama (Löding).

Calosoma scrutator *Fabricius.* Crescent City (Schwarz); Ormond April 1–4 (Blatchley); Fort Myers, March 31, at light (Davis). Occurs throughout the United States, north to Ontario, even in Lower California.

Calosoma splendidum *Mannerheim.* Key West, at electric light (Angell Coll.). Mr. C. L. Brownell, who collected the material in the Angell Collection, states that the species was on one occasion extremely abundant. It is a well-known Cuban species.

Calosoma sayi *Dejean.* Centreville, in cottonfield (Schwarz); Jacksonville (Leng Coll.); Taylor Co. (Genung). Extends northward to New York, westward to Arizona. The Cuban *C. alternatum* is closely related. Very common at light in Alabama (Löding).

Tribe Notiophilini.

The species of *Notiophilus* present so different an appearance to other Carabidæ, and are besides so differentiated by the antennæ in repose being bent down under the head and by the obliquely truncate anterior tibiæ, as well as by the very prominent eyes, that it seems best to follow Chaudoir in treating them as a separate tribe, rather than Horn who included them in the tribe Nebriini, with *Opisthius, Leistus* and *Nebria.* The crowding together of the elytra striæ toward the sides, leaving a smooth shining space each side of the suture, is unmentioned in Horn's "Genera of Carabidæ" though a most striking characteristic.

Notiophilus novemstriatus *Leconte.* Pensacola (Fall). Extends northward to New York, westward to New Mexico; Mobile and Baldwin Co., Ala. (Löding).

Tribe Scaritini.

Pasimachus marginatus (*Fabricius*). St. Augustine, Lake Worth, Crescent City (Schwarz); Punta Gorda (Slosson Coll.); Ormond, March 24, beneath log in open pine woods (Blatchley); Pablo Beach, Key West, September, Big Pine Key, September (Davis); Taylor Co. (Genung); Enterprise (Brownell); Marco, La Belle, Punta Gorda, under boards at edge of salt meadow (Davis); Florida (Casey), Big Pine Key (Davis Coll.); April and November. Not rare, occurring throughout the Gulf Strip Georgia, South Carolina, Louisiana, Texas.

Pasimachus floridanus *Casey.* Palm Beach (Casey); Miami, September (Davis); Orange Grove (M & W).

Pasimachus subsulcatus *Say.* St. Augustine, Lake Worth, Gulf Hammock, Crescent City, Key West (Schwarz); Ormond (Slosson Coll.);

Ortega, September (Davis); Tampa (Engelhardt); Ormond, April 6 (Blatchley); Enterprise, April (Davis Coll.), (Brownell); Lake City (Agl. Exp. Sta.) Marion Co., (Casey) Lakeland, Gainesville, September, March, April, May, November. Not rare, but apparently confined to Georgia and Florida.

Pasimachus opacipennis *Casey.* " Florida."

Pasimachus sublævis *Dejean.* St. Augustine (Schwarz); Gainesville, September; Suwannee Springs (Slosson); Silver Springs, (Engelhardt); Dunedin, Sarasota, Sanford, January, February, under logs in sandy woods (Blatchley); Enterprise (Brownell); Taylor Co. (Genung); Punta Gorda, under boards in pine woods (Davis); Lake Worth, Key West, (Casey). La Grange, June (Davis Coll.); Ortega, September, March, October, November, in syrup trap and under boards. Reported as rare in the first Florida list but apparently found frequently. Extends northward along the coast to Long Island.

Pasimachus strenuus *Leconte.* St. Augustine, Crescent City (Schwarz); Gainesville, September; Ormond (Slosson Coll.); Ormond, March 24, beneath chunk in open pine woods (Blatchley); Lakeland, Rital (Davis); Florida (Casey); La Grange, June, Enterprise, September (Davis Coll.); La Grange, September (Davis); March, April, May, November. Peculiar to Florida. Not found in Alabama (Löding).

The species of *Pasimachus* are found under logs, etc., under boards in damp meadow, under dry cow dung (Mr. Davis found one with a *Canthon* in its jaws), and in bottles baited with syrup. They sometimes burrow deeply, Mr. Bischoff having found them at a depth of twelve inches. In addition to the four older species, all of which he recognizes, Col. Casey has described (Memoirs on the Coleoptera, IV, 1913) two more species and two subspecies, viz.: *floridanus, opacipennis, robustus* (subsp. of *strenuus*), and *subnitens* (subsp. of *subsulcatus*). The last two are based upon single examples, and in the large series now accumulated, the characters used to separate them tend towards becoming evanescent. The first two result from the dismemberment of the heterogeneous material heretofore called *subsulcatus*, the specimens with strong nearly equal sulci being *floridanus* Casey, while those with smooth elytra are *opacipennis* Casey. The connecting link supplied by *subsulcatus* has led to the mass being heretofore regarded as one species but there is no evidence that such is the case and until such is forthcoming Casey's two species must stand. His subsp. *robustus* based upon a comparison between single specimens of it and *strenuus* may not stand, for in a larger series intermediate degrees of development partly at least bridge the differences he describes, *robustus* being a rather small specimen with the elytral ridges moderately developed. His subsp. *subnitens* is *subsulcatus* with the elytra smoother than usual and may also be bridged by intermediate forms.

The Floridian species of *Pasimachus* may be separated by the following table based on Casey's:

Hind body short, generally but very little longer than wide;
  Elytra conjointly broadly and obtusely rounded; humeral carina very short; hind tibiæ with sparse hairs within in both sexes; form stout, parallel, convex, 22–25.5 mm . . . . *sublævis.*
  Elytra obliquely and obtusely pointed behind;
    Body larger, humeral carina very short, 29.5–34 mm. . . . . *strenuus.*
    Body smaller, humeral carina long, evenly contiguous with the inner lateral ridge;
      Entire surface of elytra deeply, almost evenly sulcate, 20–22 mm. *floridanus.*
      Elytra with broad, feeble, more or less faint costæ, 21 mm. . . *subsulcatus.*
      Elytra almost perfectly smooth, 20 mm. . . . . *opacipennis.*
Hind body always evidently longer than wide, rather depressed; elytra opaque with shining elevated ridges, 27–30 mm . . . . *marginatus.*

Scarites subterraneus *Fabricius.* St. Augustine, Enterprise, Jacksonville, Crescent City, Indian River, Key West, common (Schwarz); Biscayne Bay (Slosson); Ormond (Blatchley); Enterprise (Brownell); Fort Myers, Everglade, La Grange, Lake Okeechobee and Pablo Beach (Davis); Sebastian (Genung); January, March, April, May, June, July, August, September, November. At light and burrowing in the soil. Extends northward and westward, but seems absent from the southwest. Mobile, Baldwin and Lee Co., Ala (Löding).

Scarites subterraneus subsp. **substriatus** *Haldeman.* St. Augustine, Lake Worth, Tampa (Schwarz); Sarasota, Fort Myers, March 1 to March 10, under logs in sandy woods (Blatchley, Slosson Coll.); Fort Myers (Davis); January–March, April. At light and under boards and rubbish at edge of pond. Occurs in southern and middle states, less abundant than preceding. Mobile Co., Ala (Löding)

Scarites subterraneus var. **californicus** *Leconte.* Cedar Keys, very rare on the sea beach (Schwarz); Hillsboro Co., Jan. 23, beneath logs half buried in beach sand (Blatchley). According to Schaeffer (Bull. Br. Ent. Soc. VIII, 123) occurs in Texas, southern California, Arizona, Lower California, Mexico. "Smaller than *subterraneus,* much more shining and with the striæ of elytra almost obliterated" (Blatchley). A specimen approaching the characters of this variety was found by Davis on Big Pine Key, September 9.

?Scarites alternans *Chaudoir.* Chokoloskee (?) Schaeffer. The accuracy of the locality label is open to grave doubt on account of the number of Cuban species received from the same source.

Synoptic Table of *Scarites*.

Elytral striæ, including the seventh, exceedingly deeply impressed, intervals all very convex, 24 to 30 mm., Cuba . . . . *alternans*.
Elytra striæ complete, the seventh feebly impressed, seventh interval at most feebly convex;
  Anterior tibiæ bearing usually only one denticle above the second tooth, 14 to 19 mm., U. S. . . . . *subterraneus*.
  Anterior tibiæ bearing usually two or three denticles above the second tooth, 24 to 30 mm., So. St. . . . . *substriatus*.
Elytra striæ obliterated at sides, feebly impressed on disk;
  Anterior tibiæ as in *subterraneus*, 14 mm. S. W. St. . . . . *californicus*.
  Anterior tibiæ as in *substriatus*, 24 mm., Tex. . . . . *lissopterus*.

The 10th and three or four preceding antennal joints are transverse in *subterraneus*, hardly as long as wide, while in *substriatus* they are rather more elongate.

Dyschirius pumilus *Dejean*. Crescent City, Tampa, Fort Capron (Schwarz); Lake Worth, Belleair (Slosson Coll.); Key West (Engelhardt); Enterprise (Brownell); Punta Gorda, Pablo Beach, on the beach just above high tide mark and by washing banks of inlet, Everglade (Davis); under lake-shore debris (Brownell); at light (Davis); burrowing in damp sandy soil; found also by sweeping grasses at edge of standing rain pools; the habits of all the species are similar; January, March, May, November, December. Extends northward to New York.

?**Dyschirius falciger** *Leconte*. Described from the banks of the Hillsboro River, Fla.; is doubtfully distinct from preceding.

Dyschirius pallipennis *Say*. St. Augustine (Schwarz); Pablo Beach, by washing bank of inlet, Nov. 4. Occurs also in New Jersey.

Dyschirius sphæricollis *Say*. Lake Worth (Schwarz); Fort Myers, April 1, at light (Davis); Key West ? (Angell Coll.). Extends northward to New York, and westward to Indiana.

Dyschirius erythrocerus *Leconte*. Fort Capron, Haulover, Enterprise (Schwarz); Belleair, Lake Worth (Slosson Coll.). Occurs also in New York, New Jersey, Ohio, Indiana.

Dyschirius hæmorrhoidalis *Dejean*. Biscayne Bay (Slosson Coll.). Occurs also in District of Columbia, Pennsylvania, Ohio, Indiana, Kansas.

Dyschirius globulosus *Say*. Fort Capron, Haulover, Tampa (Schwarz); Jacksonville, Lake Worth, (Slosson Coll.); Everglade (Davis Coll.); January–March, June. Extends northward to Canada, westward to Indiana.

Dyschirius filiformis *Leconte*. Fort Capron, Haulover, rare (Schwarz);

Punta Gorda (Slosson Coll.); January–March (Slosson). Occurs also in New York and New Jersey.

Dyschirius sublævis *Putzeys.* Key West ? Specimens in Leng Coll. from Roberts Coll. and Angell Coll. Originally described from Texas.

?**Dyschirius sellatus** *Leconte.* Enterprise (Castle and Laurent). Confirmation of this record is lacking; the species is known from New York and New Jersey.

A thorough study of the genus *Dyschirius* is needed, with an examination of the types, to make sure that in some cases the same species does not appear above under two names, as well as to verify the identity of the Floridian species with the northern ones of which the names are used. The same condition applies to the following genus, *Clivina.* The abundance of these small Scaritini is perhaps due to the porous damp soil of parts of Florida as well as to the southern character of the tribe, of which several hundred species, partly poorly differentiated, are described from tropical America.

Clivina morula *Leconte.* Biscayne Bay, Punta Gorda, Lake Worth (Slosson Coll., January–March); Key West ? (Roberts Coll.); Crestview, Oct. 15–16, Fort Myers, March 30, at light. Recorded also from District of Columbia and Louisiana, Mobile Co., Ala., (Löding).

Clivina americana *Dejean.* Enterprise, Crescent City, not rare (Schwarz); Sarasota, Lake Okeechobee, March, on moist banks (Blatchley); Taylor Co. (Genung); Fort Myers, April, at light (Davis); Everglade, April (Davis); Enterprise, December, under lake shore debris (Brownell). A widely distributed species, in damp sandy river banks, north to New York, west to Indiana and Texas.

Clivina striatopunctata *Dejean* (*picea* Putzeys included as a synonym). Enterprise, Tampa (Schwarz); Monticello, Oct. 4–8; Lake Worth (Hamilton); St. Augustine, Crescent City, Tampa, Centreville (Schwarz); Biscayne Bay (Slosson Coll.); Enterprise, November, December, under lake shore debris (Brownell). Extends northward to New Jersey, and Staten Island, New York (where it is found on salt meadow), westward to Louisiana.

Clivina bipustulata (*Fabricius*). Punta Gorda, Jacksonville, abundant with *Ega sallei* at edge of brooks and streams (Slosson Coll.); St. Lucie, (Schwarz); Sarasota, Lake Okeechobee, March 4, March 11, on moist banks (Blatchley); Fort Myers, Lake Okeechobee, April, at light (Davis). Extends northward to Staten Island, New York (where it is found like *Scarites subterraneus* in garden soil), westward to Louisiana and Indiana. Mobile and Baldwin Co., Ala., common (Löding).

Clivina dentipes *Dejean.* Enterprise, Dec. 12, under lake shore debris (Brownell); Florida, not rare (Schwarz). Extends northward to

New York, westward to Texas and Indiana. Very common in Mobile Co., Ala. (Löding).

Clivina cordata *Putzeys.* Biscayne Bay (Slosson Coll.); "Fla." (Schaupp Coll. identified by Leconte). Described from Louisiana, apparently seldom recognized.

Clivina rufa *Leconte.* Enterprise, rare (Schwarz); Taylor Co., March (Genung); Fort Myers, April 23 (Davis). Extends northward to New Jersey, westward to Kansas. Mobile Co., Ala (Löding).

Clivina rubicunda *Leconte.* Enterprise, one specimen (Schwarz); Hillsboro Co., Jan. 16 (Blatchley). Extends northward to New Jersey, westward to Louisiana and Illinois.

The *C. picipes* Putz. of the first Florida list, I fail to recognize. If an error for *picea,* the records should be included with those for *striatopunctata.* If an error for *fissipes* Putz. the records should be included with those for *dentipes.* In addition to those names noted above, Mr. Löding finds *ferrea* (?) and *pallida* in Mobile Co., Ala.

Aspidoglossa subangulata (*Chaudoir*). Not rare (Schwarz); Lake Worth, Jacksonville (Slosson Coll.); "Fla." (Blatchley); Clearwater, April 28; Fort Myers, Everglade, Lake Okeechobee, March, April, May (Davis). At light, in grassy field, under dry grass, in humus. One of the most common Floridian species, also very common in Mobile Co., Ala. (Löding), extending to District of Columbia on the Atlantic coast and westward to Texas.

Schizogenius sallei *Putzeys.* Lake Altapopka, very rare (Schwarz); Enterprise, October, December, under lake shore debris (Brownell). Described from Texas.

Schizogenius ferrugineus *Putzeys.* Fernandina, two specimens on the sea beach (Schwarz). Extends northward to New Jersey, westward to Texas.

Ardistomis obliquata *Putzeys.* Not rare (Schwarz); Lake Worth (Hamilton); Enterprise (Castle & Laurent); Biscayne Bay, Crescent City (Schwarz); Miami (Slosson Coll.); Arch Creek, February, March, Lake Okeechobee, March, on moist banks (Blatchley); Sebastian, August (Genung); Fort Myers, Everglade, Lake Okeechobee, March, April, May, June (Davis). At light, sweeping grassy meadows, under dry grass in humus; a most abundant species; rarely reported outside the extreme southern states.

Ardistomis viridis (*Say*). Common (Schwarz); St. Augustine, Lake Worth, Biscayne Bay (Schwarz); Punta Gorda, Jacksonville, Belleair (Slosson); Arch Creek, February, March, Lake Okeechobee, March, on moist banks (Blatchley); Tampa, April, October; Fort Myers, Marco, Lake Okeechobee (Davis); Gainesville, September, October, Monticello, Oct. 4–8. Occurs in Florida, with the preceding, but extends further north and west, reaching New York, Indiana, Texas, common in Mobile and Baldwin Co., Ala. (Löding).

Ardistomis puncticollis *Putzeys.* Cited by Mr. Schwarz as very rare but reported since quite often. St. Augustine, Crescent City, Haw Creek (Schwarz); Lake Worth, Biscayne Bay (Slosson); Florida (Blatchley); Enterprise, November, December (Brownell); Lake Okeechobee, April, May (Davis). Confined to Florida except for Blatchley's Indiana records.

Ardistomis schaumii *Leconte.* Common (Schwarz); Miami, Biscayne Bay, Belleair (Slosson); Dunedin, Arch Creek, Lake Okeechobee, January, February, March (Blatchley); Monticello, Oct. 4–8 Enterprise, Oct. 14 (Brownell). Confined to Louisiana and Florida.

Ardistomis morio (*Dejean*). Fort Myers, March 30, at light (Grossbeck). This species, in which the striæ of the elytra are punctate in front, must be added to the list. Described from Georgia.

In concluding the enumeration of Floridian Scaritini, it may be interesting to compare the total of thirty-six species with the twenty-seven cited as inhabiting New Jersey, by Smith, as an illustration of the extent to which the tribe becomes developed in southern latitudes. The comparison is liable to become more striking when the smaller Floridian species are more thoroughly studied, and the increased number in this tribe is contrasted with the general paucity of carnivorous beetles in the state. It is a southern tribe, gradually diminishing in number of representatives as one traces its distribution northward until it finally fails completely in Newfoundland and Labrador.

Subfamily HARPALINÆ.

Tribe Panagæini.

Panagæus crucigerus (*Say*). Haulover, Lake Harney (Schwarz); Punta Gorda, Lake Worth, Biscayne Bay, Ormond (Slosson Coll., January–March); Fort Myers, March 30, at light (Grossbeck). Extends northward to New Jersey, westward to Louisiana and Indiana. Nowhere common. Mr. Löding finds it rarely in the city of Mobile in July.

Panagæus fasciatus (Say). Fort Capron, Sebastian (Schwarz); Lake Worth (Dietz); Fort Myers, April 2, at light (Davis). Extends northward to New York, westward to Kansas. Under stones, etc., in dry, sandy places; not common. Mobile Co., Ala., February, March, July (Löding).

Tribe Morionini.

Morio monilicornis *Latreille,* Tampa, St. Augustine, Lake Poinsett, not rare, under old pine bark (Schwarz); Punta Gorda, Tarpon Springs (Slosson Coll. January–March); Silver Springs, Nov. 25 (Engelhardt); Ormond, March, frequent between bark of pine logs and snags (Blatchley); Enterprise, September, November (Brownell). Extends northward to North Carolina, westward to Lower California; occurs also in the West Indies. Common under pine bark in Alabama (Löding).

Tribe Bembidiini.

Many of the records quoted below were made before the late Roland Hayward's studies in the tribe were published and to some extent disagree with the distribution given by him for the species. Such are preceded by an interrogation to indicate the doubt that must exist until the data are reconciled.

Bembidium contractum *Say.* Common, near the sea coast, from Massachusetts to Florida (Schwarz, Hayward); Punta Gorda, Lake Worth (Slosson Coll. January–March); Dunedin, Sarasota, Arch Creek, January, March, on beach of gulf and bays (Blatchley); Key West ? (Leng Coll.); Everglade, Fort Myers, April, May, June, July (Davis); Clearwater, April 28 (Van Duzee); at light and in salt marshes.

Bembidium constrictum *Leconte.* Occurs with the preceding and not easily separated from it. Lake Worth, Biscayne Bay (Slosson); Key West Nov. 21 (Engelhardt). Extends north to Canada and west to New Mexico (Hayward).

?**Bembidium affine** *Say.* Cited but not seen by Schwarz; occurs along Atlantic coast, New England to Florida, and west to Arizona (Hayward). No definite Floridian recent records are known, but the name is included in the Cuban list.

Bembidium versicolor *Leconte.* Not rare (Schwarz); St. Augustine (Johnson); "Fla." (Slosson Coll. January–March); Enterprise, Nov. 12, under lake shore debris (Brownell); Fort Myers, Nov. 15, at light; Punta Gorda, Nov. 16 (Davis). The specimens I have seen are darker and smaller than the usual northern form; Hayward gives "United States and Canada reaching to Newfoundland, Anticosti Island and Manitoba" and Texas and southern California, but does not mention Florida, apparently including Floridian specimens with *affine.* Blatchley cites *flavopictum* Mots. which

Hayward treats as a synonym of *versicolor,* perhaps erroneously, if *flavo-pictum* is conspecific with the darker Floridian form.

Bembidium lævigatum *Say.* Tallahassee (Schwarz). Extends northward to New Hampshire, westward to Texas and Montreal.

?**Bembidium inæquale** *Say.* Included only on Hayward's statement quoted by Schwarz. Has the same range as preceding.

?**Bembidium assimile** *Gyllenhal.* St. Augustine (collected by Johnson, determined by Hamilton). Occurs in Europe and in our northern regions as far south as Virginia (Hayward).

?**Bembidium fraternum** *Leconte.* Sanford, March 27, on lake shore. (Blatchley). Described from Habersham Co., in the mountains of Georgia. Hayward has associated under this name specimens from Louisiana, Virginia, Pennsylvania, and Nantucket.

To the northern collector the small number of species of *Bembidium,* eight in all, even including the four doubtful cases, is a marked feature of the Floridian fauna. A method of collecting, very productive in the north, possibly not yet tried in Florida, consists in examining banks of streams and ponds at night.

?**Anillus dohrni** *Ehlers.* Florida (Ehlers). This record has been questioned by Mr. Schwarz in the Proc. Ent. Soc. Wash.

Tachys ænescens *Leconte.* Enterprise, very rare (Schwarz); Marco, April 20 (Davis). Florida, Louisiana, North Carolina, Arkansas (Hayward).

Tachys nanus *Gyllenhal.* Common under bark in Florida, United States, also Eurasia.

Tachys flavicauda *Say.* Common under bark from Canada to Florida and westward to California.

Tachys granarius *Dejean.* Common from Canada to Florida and westward to Nebraska. In the damp soil and at light; found also in sifting shore debris at mouth of Peace River.

Tachys incurvus *Say.* Common from Canada to Florida and westward to Pacific Coast. In the soil; northward it is frequent in nests of *Formica exsectoides;* with preceding at mouth of Peace River, also on bank of St. John's River; Monticello, Oct. 4–8.

Tachys fuscicornis *Chaudoir.* Biscayne Bay (Slosson Coll., January–March); Punta Gorda, Nov. 12, around pools (Davis). Described from Louisiana; cited in Smith's New Jersey List.

Tachys xanthopus *Dejean.* Common (Schwarz); Dunedin, Sanford, Sarasota, Ormond, St. Petersburg, Bassenger, January to April in moist places beneath cover (Blatchley); Everglade, July (Davis Coll.); Fort Myers, at light, Nov. 15 (Lutz); Monticello, Oct. 4–8. Massachusetts to Florida (Hayward). Cited in District of Columbia, New Jersey and Indiana Lists.

Tachys capax *Leconte.* Jacksonville (Slosson Coll.); St. Augustine (Johnson); Lakeland, Nov. 10; Punta Gorda, Nov. 12, around pools (Davis); District of Columbia, New Jersey, Florida, Missouri, Iowa, Indiana (Hayward).

Tachys lævus *Say.* Common (Schwarz); Jacksonville (Slosson Coll. January–March); Florida, more common with *xanthopus* (Blatchley); Lakeland, Nov. 8, sifting leaves on shore of Lake Parker; Canada to Louisiana (Hayward).

Tachys pallidus *Chaudoir.* Haulover, Tampa, very rare (Schwarz); Everglade, April 9 (Davis). Described from Texas; known also from New Jersey.

Tachys occultator *Casey.* Charlotte Harbor, Biscayne Bay (Slosson Coll. January–March); Key West ? (Leng Coll.); Everglade, April, May, June, July, Ocean Beach, Miami, September (Davis); Fort Myers, April; New Jersey to Florida and Texas (Hayward). This is a salt marsh species, occasionally coming to light. It varies in color more than the descriptions indicate.

Tachys albipes *Leconte.* Fort Capron, Sand Point, Enterprise, Tampa, rare (Schwarz); Sebastian, August (Genung). Confined to Florida and Louisiana.

Tachys ventricosus *Leconte.* Sebastian, August (Genung). Mr. Schwarz says "common," but this is hardly corroborated by recent results. Confined to Florida and Louisiana.

Tachys scitulus *Leconte.* Everglade, May, June, July; Fort Myers, March 30 (Davis). Hayward gives Massachusetts to North Carolina only.

Tachys columbiensis *Hayward* (Zimm. mss.). St. Augustine, Lake Worth, common (Schwarz); Enterprise, November, December, in lake shore debris (Brownell); Monticello, Oct. 4–8, Gainesville, September, October; South Carolina, Florida (Hayward); Florida (Blatchley).

Tachys corruscus *Leconte.* Biscayne Bay (Slosson Coll. January–March); Florida, same places as *xanthopus* (Blatchley); Punta Gorda, Nov. 16, sifting debris on shore of Charlotte Harbor. Canada and Massachusetts to Florida (Hayward).

Tachys pumilus *Dejean.* Daytona, Nov. 10 (Engelhardt); under the name *umbripennis,* which Hayward considers a synonym, Biscayne Bay (Schwarz). The records for this species are not numerous and include District of Columbia, Louisiana, Texas.

In addition to the above named species of *Tachys,* Mr. Schwarz originally cited *T. carolinus* Zimm. mss., a name not recognized by Hayward, and three unnamed species, presumably now covered by names given above; the following species, viz., *dolosus, nebulosus, bradycellinus,* may, from their known occurrence in Louisiana and other southern states, be reasonably expected to occur in Florida. Mr. Löding includes also *T. misellus* Laf. in his Alabama list and *T. ephippiatus* Say.

Notwithstanding the considerable number of species of *Tachys*, many of which are widely distributed, the whole tribe Bembidiini is represented by but twenty-five species against forty recorded for New Jersey, the tribe being apparently of northern origin, and except for the widely distributed little *Tachys*, of cortical and riparial environment, and the salt marsh Bembidium, has scarcely been able to establish itself in Florida. The condition existing in Scaritini are apparently reversed in this tribe.

Tribe Pogonini.

Pogonus lecontei *Horn.* Ormond (Slosson Coll. January–March). Known also from New Jersey and Texas.

Tribe Pterostichini.

Pterostichus ebeninus *Dejean.* "Fla." (Slosson Coll. January–March); under the name *acutangulus* Chaudoir, which is synonymous, Fort Capron, Tampa, very rare (Schwarz). Extends northward to New York, westward to Illinois and Texas. Mobile Co., Ala., subaquatic (Löding).

Pterostichus erythropus *Dejean.* St. Augustine (Johnson). Extends northward to Connecticut (Champlain, Psyche, XVIII, p. 36) and westward to Indiana. Mr. Löding has not found it in Alabama.

Pterostichus fallax *Dejean.* Suwannee, Pensacola, Jacksonville (Slosson Coll. January–March). A southern species found also in Georgia and Texas; Mobile and Baldwin Co., Ala. (Löding).

?**Pterostichus permundus** *Say.* Jacksonville, April 21 (Laurent). Described from Indiana and known also from Illinois, Missouri and Nebraska. Found in Alabama by Löding but only in northeastern part of the state.

Mr. Löding finds in South Alabama the following species, not so far known from Florida, viz., *sayi*, Mobile Co., June and July;

Lophoglossus haldemani *Leconte.* Jacksonville (Castle and Laurent). A rare species found near margins of cypress swamps. Reported also from Mobile Co., Ala., 2 specimens (Löding); and from Indiana.

Lophoglossus tartaricus *Say.* Cited as from northern Florida but not seen by Mr. Schwarz. Found in New Jersey and in Indiana, sandy localities near water; Mobile Co., Ala., subaquatic (Löding).

Piesmus monedulus *Germar* (**submarginatus** Say). Tallahassee, Chuluota (Schwarz); Pensacola (Slosson Coll.); Ormond, March, April, beneath bark of pine logs (Blatchley); Taylor Co., January, March (Genung). Confined to Southern States, Mobile and Baldwin Co., Ala., under bark of pine and oak (Löding).

Casey (Memoirs IV, 1913, p. 143) restricts the name *submarginatus* to specimens from North Carolina, in which the striæ are coarse, moderately impressed, distinctly but not extremely punctured, and calls the Florida specimens with distinctly shorter elytra, the striæ of which are extremely coarse, in fact sulciform, and still more coarsely and conspicuously punctured, *monedulus* Germar. Germar's name having priority by about a year would also take precedence of Say's if Casey's view were not acceptable.

The species *ventralis* Say (*cycloderus* Chaudoir), *obscurus* Say and *tumescens* Lec. differ so widely by the coarse punctuation of the under surface that they may require a new genus. Though they constitute a separate section "B" in Schaupp's synopsis, the distinguishing character does not receive sufficient prominence, and "abdomen punctate" might with advantage be added to 18th line on p. 23, following the words "scutellar stria short."

?**Pterostichus ventralis** *Say*. "Fla." (Bull. Br. Ent. Soc., v. p. 41). There is no confirmation of this record and the known distribution does not support it. Occurs also in Louisiana, Kansas, Missouri.

Ferestria n. gen.

The four species that follow, with *approximatus*, constitute a section of the tribe Pterostichini, which looks very different from the remainder on account of the more or less complete absence of the elytral striæ. I propose to separate them under a new genus, named *Ferestria* and defined as follows:

Thorax strongly rounded in front of the sides, deeply sinuate behind, with small but distinct rectangular hind angles in some species, obtuse hind angles in others; elytra short, scarcely half as long as body, with the external striæ more or less obsolete, all the striæ feebly impressed, and one dorsal puncture behind the middle; each ventral segment with two distant setigerous punctures near hinder margin; designating *Pterostichus lævipennis* Lec. as the type, since in that species the characters which isolate the new genus are most marked.

Ferestria obsoleta (*Say*). Tampa, in the pine woods under sticks, rare (Schwarz); Gulf Hammock (Castle and Laurent); Key West (Angell Coll.). Described from Indiana, known also from Illinois, Ohio, and Texas. Found by Löding only in northern Alabama.

Ferestria acuta (*Leconte*). Tallahassee (Schwarz); "Fla." (Schaupp Coll.). Confined to Florida, Georgia, Louisiana. Mr. Löding finds a species near *acuta* in Mobile Co., October–December.

Ferestria lævipennis (*Leconte*). St. Augustine (Schwarz); Enterprise, April 20 (Brownell). Confined to Florida and Georgia.

Ferestria morio (*Dejean*). Enterprise, rare (Schwarz); Lake Worth (Slosson Coll. January–March); Dunedin, Jan. 17, beneath chunk near border of Lake (Blatchley); "Fla." (Schaupp Coll.). Confined to Florida and Alabama. Mobile and Baldwin Co., Ala., all year (Löding).

In addition to above *F. approximatus* (Leconte) is reported from Jacksonville, but I believe this name belongs to the more northern form found in District of Columbia and Pennsylvania. As to the localities in which the genus occurs, it may be added that near Clayton, Ga., a few specimens were found under stones near a brook in a pasture.

Evarthrus faber (*Germar*). Tampa, very rare (Schwarz); Pensacola, Atlantic Beach, Punta Gorda, Suwannee, Jacksonville (Slosson Coll. January–March); La Belle, April 27 (Davis); "Fla." Very common at six widely separated localities (Blatchley); (Schaupp Coll.); Florida and New York (*teste* Schaupp).

Evarthrus seximpressus *Leconte*. Enterprise, Cedar Keys, rare, Haw Creek (Schwarz); Enterprise, March (Brownell). Illinois, Indiana, Kansas, Texas, Louisiana, Mobile Co., Ala. (Löding).

Evarthrus americanus *Dejean*. One specimen, Polk Co. (Schwarz); Jacksonville, April 21 (Laurent); Jacksonville (Slosson Coll., January–March); Lakeland, Nov. 17, at light (Davis); "Fla." (Schaupp Coll.); Indiana, Texas, Louisiana, Georgia. A specimen was found in the pine woods at South Jacksonville drowned in a discarded beer bottle part full of rain water. Mobile Co., Ala. (Löding).

?**Evarthrus nonnitens** *Leconte*. Jacksonville, April 21 (Laurent). Texas and Louisiana. This and the following are not found in Alabama by Löding, but he cites instead *sigillatus* and *rotundatus* on authority of Dr. E. C. Van Dyke.

?**Evarthrus engelmanni** *Leconte*. Ormond (Slosson Coll., January–March); Texas.

Amara impuncticollis *Say*. "Fla." (Hayward). "Occurs from Canada to Florida and Louisiana. Mobile and Baldwin Co., Ala." (Löding). Löding takes also *A. cupreolata* Putz.

?**Amara musculus** *Say*. "Fla." (Say quoted by Schwarz). Possibly an error for *Evolenes* which looks like *A. musculus* superficially. Mobile Co., Ala. (Löding).

?**Amara crassispina** *Leconte*. Recorded from Alabama, but not found there by Löding, who cites instead *A. exarata.* *A. crassispina* was described from Lake Superior.

Loxandrus reflexus *Leconte.* Fort Capron, Enterprise, Cedar Keys, Tampa, common (Schwarz); St. Augustine (Schwarz, Slosson); Sarasota, Lake Okeechobee, February, March, under logs at border of ponds (Blatchley); Taylor Co. (Genung); Marion Co. (Leng Coll.). Confined to Florida and Alabama (Mobile Co., Löding).

Loxandrus calathinus *Leconte.* Tampa, not rare (Schwarz); Everglade, May, June, July, Miami, September (Davis). Confined to Florida.

Loxandrus floridanus *Leconte.* Fort Capron, Tampa, Enterprise, common (Schwarz); Miami, Lake Worth, Biscayne Bay, January–March (Slosson). Confined to Florida.

Loxandrus brevicollis *Leconte.* Biscayne Bay, under seaweed and debris on the beach together with *L. celeris* and *floridanus,* running swiftly when disturbed (Slosson Coll. January–March). Found in northern Alabama by Löding.

?Loxandrus erraticus *Dejean.* Enterprise, very rare (Schwarz). This name is generally applied to specimens usually with dark legs, from District of Columbia, Indiana, and other northern localities. Its occurrence in Florida rests upcn the original Schwarz record unconfirmed since 1876; it is, however, found in Mobile Co. by Löding.

Loxandrus celeris *Dejean.* Fort Capron, Enterprise, rare (Schwarz); Miami, Biscayne Bay (Slosson Coll., January–March); (Blatchley); Enterprise (Schaupp Coll. and Brownell); Everglade, May (Davis Coll.); Fort Myers, April 26, under boards and rubbish at edge of pond. Occurs also in Texas and a closely related species, which also has a reddish sutural spot, is found in Cuba.

Loxandrus agilis *Dejean.* Common (Schwarz). Gainesville (J. R. Watson) Lake Worth (Hamilton); Jacksonville (Castle and Laurent); Belleair (Slosson Coll. January–March); Sanford, Sarasota, January–March, beneath cover at border of ponds (Blatchley); Punta Gorda, Nov. 15 in syrup trap. Extends northward to Pennsylvania and Indiana; Mobile Co., Ala. (Löding).

Loxandrus rectus *Say,* not Leconte (*velox* Dejean, included as synonym). St. Augustine (Schwarz); Atlantic Beach (Slosson Coll. January–March); Sarasota, Oneca, Utopia, January, March (Blatchley); Paola (Genung). Extends northward to Georgia, and Indiana; Mobile Co., Ala. (Löding). *L. rectus* in most collections that I have seen is erroneously used for a species 14 mm. or more in length with yellow legs, the *L. lucidulus* of Dejean. It is true that Say gave the length as $\frac{3}{5}$ inch but he undoubtedly meant $\frac{3}{10}$, for his description of the punctures of the striæ, of the rounded hind angles of the thorax, and especially his comparison with *Stenolophus ochropezus,* absolutely disagree with the larger insect. Leconte in 1846, guided perhaps by specimens received from Melsheimer, Ziegler or Haldeman, who were likely to have derived the name from Say, treated *rectus* as it is treated here; and he appears to have hastily changed his identification later on observing the printed length. His later description of the hind angles is incorrect, differing from his own earlier description and from Say's original description.

Loxandrus rectangulus *Leconte.* Enterprise, two specimens (Schwarz). Rests upon these original specimens and possibly a synonym.

Loxandrus crenatus *Leconte.* Not rare (Schwarz); Jacksonville (Slosson Coll. January–March); Enterprise (Schaupp Coll.); Lakeland, Nov. 9, caught by sifting leaves on shore of Lake Parker; Sebastian, Aug. (Genung). Confined to Florida and Alabama, Mobile Co. (Löding).

In addition, Blatchley cites *L. saphyrinus* Chaudoir, which name was also used by Austin for specimens from Tampa, but it appears to me that Florida specimens are all *reflexus.* There is very little to separate *reflexus* from *saphyrinus,* of which it seems to be the Floridian representative, but if Leconte's name is used, it must exclude Chaudoir's. Mr. Löding in Alabama finds also *lucidulus, lucens, minor* and *iris.* It may be noted in concluding the tribe Pterostichini, that feebly represented as it is in Florida (thirty species against forty-six in New Jersey), that representation is mainly composed of the genera *Loxandrus, Evarthrus* and *Ferestria,* hardly known near New York; the typical *Pterostichus* and *Amara* of northern woods having scarcely any standing in Florida. Furthermore, a glance at the localities given shows that it is mainly the northern half of the State that shelters what remains of the tribe, especially in *Evarthrus* and *Lophoglossus.* It is therefore in keeping with these facts that *Loxandrus,* the one strongly Floridian genus, should be the only one known in Cuba, its beach environment being possibly suggestive of the method of transportation.

Tribe Licinini.

Diplochila laticollis *Leconte.* Biscayne Bay, Lake Worth (Slosson Coll. January–March); Ormond, March 17, beneath bark (Blatchley); Fort Myers, March 30, at light (Davis). Extends northward to Connecticut (Champlain, Psyche, XVIII, p. 36), westward to Nebraska. Common at light in Mobile Co., Ala. (Löding).

Diplochila major *Leconte.* Common (Schwarz); Lake Worth (Hamilton); Biscayne Bay (Slosson Coll. January–March); Fort Myers, March 30, at light; Everglade, June (Davis); Crescent City, April 20. Extends northward to New Jersey, westward to Indiana. Common at light in Mobile Co., Ala. (Löding).

Diplochila nupera *Casey.* Lake Worth (Casey); Biscayne Bay (Slosson Coll. January–March); Arch Creek, March 21 (Blatchley); Everglade, June and July (Davis). Described from Florida, thus far unknown outside the State.

Dicælus purpuratus *Bonelli.* Between Allen River and Deep Lake, April 13 (Davis); "Fla." (Leng Coll.); "Fla." (Bull. Br. Ent. Soc. III, p. 52). Extends northward to Connecticut (Champlain, Psyche, XVIII, p. 36), westward to Missouri. The purple color is barely evident by artificial light. Mobile and Baldwin Co., Ala., common (Löding).

Dicælus quadratus *Leconte.* Cedar Keys, very rare, Biscayne Bay (Schwarz); Fort Myers, March 6 (Blatchley); Taylor Co. (Genung). Confined to Florida and Alabama (Magazine Point, Mobile Co., Löding).

Dicælus carinatus *Dejean.* Lake Harney, one specimen, Biscayne Bay, Busk Key (Schwarz); St. Petersburg, Jan. 17, beneath chunks in low damp woods (Blatchley); Taylor Co. (Genung); Lakeland, May 7; Big Pine Key, September (Davis); Key West. Confined to Florida, Alabama and Georgia. Mobile Co., Ala., rare, but found in several localities (Löding).

Dicælus alternans *Dejean.* Lake Harney, Enterprise, Tampa, St. Augustine, Crescent City, Lake Poinsett (Schwarz); Altamonte, Ormond, Biscayne Bay (Slosson Coll. January–March); Punta Gorda, under wood by roadside, Nov. 12. Confined to Florida and Georgia.

Dicælus elongatus *Dejean.* Enterprise, very rare, St. Augustine, Crescent City (Schwarz). Extends north to Connecticut, west to Illinois and Texas. Mobile Co., Ala. (Löding).

Dicælus crenatus *Leconte.* Tallahassee (Barber); occurs also in Louisiana, Texas and Alabama, Mobile Co. (Löding).

Dicælus subtropicus *Casey.* Palm Beach (Kinzel). Described in Memoirs IV, p. 151, and said to differ from *ovalis* and *furvus* in its narrower form, thoracic impressions and alternately distinctly wider and more convex strial intervals.

?**Dicælus politus** *Dejean.* "Fla." (Bull. Br. Ent. Soc. III, p. 52). Abundant in District of Columbia, Pennsylvania, New York, extends to Connecticut, but recent confirmation of its occurrence in Florida is lacking. Found only in Madison and St. Clair Co. in northern Alabama by Löding.

?**Dicælus furvus** *Say.* "Fla." (Bull. Br. Ent. Soc. III, p. 52). This species also occurs in Kentucky, Ohio, Indiana, Missouri, etc., and has not recently been reported from Florida.

Badister elegans *Leconte.* Haw Creek (Schwarz). Rare in New Jersey, also Texas.

Badister micans *Leconte.* Fort Capron, Lake Harney, Tampa, not rare, Biscayne Bay (Schwarz); "Fla." (Brownell). Extends northward to Massachusetts, westward to Indiana.

Badister reflexus *Leconte.* Suwannee (Slosson Coll. January–March). Extends northward to New York, westward to Indiana.

Badister flavipes *Leconte.* Fort Capron, Enterprise, Tampa, rare (Schwarz); one specimen, Little River, March 16 (Blatchley); Sebastian, August (Genung). Extends northward to New York; no records known to me outside the Atlantic States.

The species of *Badister* look out of place in this tribe, resembling strongly *Stenolophus.* The definition of the tribe given by Horn is replete with exception and it may later be advisable to remove Badister.

Tribe Platynini.

Calathus gregarius *Dejean.* "Fla." (Bull. Br. Ent. Soc. VI, p. 49). A northern species not recently found in Florida. In Alabama Mr. Löding finds *C. opaculus* only.

Platynus cincticollis *Say.* St. Augustine, Crescent City (Schwarz); Dunedin, Sanford, Sarasota, Eustis, Kissimmee, January, March, beneath cover at border of ponds (Blatchley); Enterprise, Dec. 12. (Brownell); Key West. Occurs throughout the middle and southern states. Mobile and Baldwin Co., Ala (Löding).

Platynus decorus *Say.* Tampa, common (Schwarz); Crescent City (Schwarz); Dunedin, Sarasota, (scarce) January, April (Blatchley). Also occurs throughout the middle and scuthern states. Mobile and Baldwin Co., Ala. (Löding).

Platynus floridanus *Leconte.* Common, St. Augustine, Biscayne Bay, Jupiter, Crescent City, Miami (Schwarz); Lake Worth (Hamilton); Enterprise (Castle and Laurent); Ormond (Slosson Coll. January to March); "all the places I collected, common, damp places under cover" (Blatchley); Jacksonville (Genung); Punta Gorda, Nov. 17, caught by beating bushes between beach and salt meadow. Confined to Florida.

Platynus æruginosus *Dejean.* Monticello, Oct. 4–8, 1914 (Mutchler & Watson). Occurs in Atlantic States northward to Massachusetts, not previously reported from Florida. The specimens from Florida are more robust than those I have seen from more northern regions and may require a varietal name later.

Platynus punctiformis *Say.* Haulover, Enterprise, Haw Creek, Bartow, Tallahassee (Schwarz); Lake Worth (Hamilton); Jacksonville

(Slosson Coll. January–March); Daytona, Nov. 10 (Engelhardt); Florida, common, same as *floridanus* (Blatchley); Enterprise, Dec. 12, in lake shore debris (Brownell); Titusville, Nov. 8, at light; Punta Gorda, Nov. 17, beating bushes; Everglade, June (Davis Coll.). Extends northward to Lake Superior. Common in Mobile and Baldwin Co., Ala. (Löding). *P. rubripes* also occurs in Mobile Co., Ala.

Platynus octopunctatus *Fabricius.* Tampa, one specimen (Schwarz); "Fla." (Leng Coll.). Middle and western states. Mobile Co., Ala., rare (Löding).

Platynus picticornis *Newman.* Upper St. John's River, under drift wood (Schwarz). Reported from Florida, Illinois, District of Columbia (?).

Platynus nutans *Say* var. **striatopunctatus** *Dejean* (and including *crenulatus* Leconte as a synonym). Jacksonville, April 21 (Laurent); Punta Gorda, Nov. 17, Fort Myers, March 30, at light, April 26, April 11, under boards at edge of pond and sweeping grassy meadow, Lake Okeechobee, April 29–May 2, very abundant (Davis); Enterprise, Dec. 12 (Brownell); Key West; Lake Okeechobee, April, under boards and on corn blossoms (Grossbeck). *P. nutans* occurs in Pennsylvania, Kansas, etc., the variety *striatopunctatus* in the southern states. The specimens which Messrs. Davis and Grossbeck found abundant at Lake Okeechobee show little evidence of the strial punctures supposed to characterize the southern race. *P. crenulatus* is found in Mobile Co., Ala., rare (Löding).

Platynus limbatus *Say.* "Fla." (Bull. Br. Ent. Soc. III, p. 57); Key West ? (Leng Coll.). Occurs also in South Carolina, Georgia, Texas and Alabama., Mobile, Baldwin and Lee Co. (Löding).

Olisthopus parmatus (*Say*). Crescent City (Schwarz). Extends northward to New York, westward to Indiana.

Perigona pallipennis *Leconte* (including *nigriceps* Dejean as a synonym). Enterprise, rare, Crescent City (Schwarz); Lake Worth (Slosson Coll. January–March); Enterprise, April, November, under rubbish (Brownell); Biscayne Bay (Leng Coll.). Rare but occasionally found in North Carolina, District of Columbia, New Jersey, Indiana.

The tribe Platynini is generally northern in habitat, forty-two species are recorded for New Jersey, eleven for Florida, of which two only seem to be frequently found. *P. nutans* is, north at least, often found in trees; the others are usually found under stones, etc., in damp places. It may prove that there are more species in the northern and western part of the state.

Tribe Anchonoderini.

Euphorticus pubescens *Dejean.* Common (Schwarz); Suwannee Springs (Slosson); Biscayne Bay (Slosson); Monticello, Oct. 4–8, Lakeland, Nov. 10, about grassy pool in white sandy plain caught by pouring water on the bank; Lakeland, May (Davis); Taylor Co., May (Genung); Enterprise, October (Brownell). Occurs only in Georgia, Florida and Alabama, Mobile Co., April, May, where *Atranus pubescens* is also found (Löding).

Tribe Ctenodactylini.

Leptotrachelus dorsalis *Fabricius.* Fort Capron, very rare (Schwarz); Jacksonville, January–March (Slosson Coll.); Lake Okeechobee, April 30 (Davis); Enterprise, November, at light (Brownell); Fort Myers, April 1, sweeping in grassy meadow. Extends westward to Kansas and northward to New York, where it occasionally comes to light and has once been found in numbers between the layers of cattail stems. Mobile and Baldwin Co., Ala. (Löding). Reported also from Cuba.

Tribe Odacanthini.

Casnonia pennsylvanica *Linné.* Sarasota, Miuku, on the ground in dry places, January, February (Blatchley); Taylor Co. (Genung); Key West, September (Davis). Extends northward to Massachusetts, westward to California. Common in Mobile Co., Ala. (Löding). The black spots on the elytra are larger in specimens from Texas and Florida.

Casnonia ludoviciana *Sallé.* Fort Capron, Sand Point, Lake Harney, Cedar Keys, not rare (Schwarz); Lake Worth, Biscayne Bay (Slosson Coll., January–March); St. Lucie, Miami, Sebastian River (Schwarz); Lake Okeechobee, April 30 (Davis); one only (Blatchley). Extends northward to Camden, N. J., where it has been found by Wenzel, westward to Louisiana; Mobile Co., Ala., May, rare (Löding).

Tribe Dryptini.

Galerita janus *Fabricius.* St. Augustine, Jacksonville, Tallahassee (Schwarz); Ormond, Punta Gorda, Belleair (Slosson Coll., January–March); Punta Gorda, in syrup trap, Nov. 15; Fort Myers, March 30, at light. Extends northward to New York, westward to Kansas. Mobile and Baldwin Co., Ala. (Löding).

Galerita lecontei *Dejean.* Fort Capron, Sand Point, Enterprise, not rare, found also on sugared trees (Schwarz); Lake Worth (Hamilton); "Fla." (Blatchley); Monticello, Oct. 4–8. Reported also from South Carolina, Texas, Colorado and Alabama (Mobile and Baldwin Co., Löding).

Galerita bicolor var. **obliqua** *Casey*. Lake Worth, (Casey, type locality); "Fla." (Blatchley); Fort Myers, April 1, April 23, at light (Davis); Everglade, May, June, July (Davis Coll.). The variety, so far as known, is confined to Florida. Mr. Löding finds the species in Mobile and Baldwin Co., Ala.

Galerita thoracica *Casey*. "Fla." (Casey).

?**Agra** sp. With much doubt, this genus is included on a reported capture of a specimen at Archer by Koebele.

Diaphorus lecontei *Dejean*. Enterprise, Tampa, very rare, also attracted by light, Crescent City (Schwarz); Enterprise, April (Brownell). Occurs also in Georgia and Florida.

Thalpius pygmæus *Dejean*. Very rare (Schwarz); Enterprise, Nov. 17 (Brownell). Occurs also in Louisiana and Texas.

Thalpius dorsalis *Brullé*. Jacksonville (Slosson Coll., January–March). Extends northward to District of Columbia, westward to Louisiana.

Tribe Egini.

Ega sallei *Chevrolat*. Enterprise, Cedar Keys, Tampa, common (Schwarz); Suwannee, Punta Gorda, Jacksonville, Belleair (Slosson Coll., January–March); Enterprise, October (Brownell); Monticello, Oct. 4–8. Occurs also in Louisiana and Alabama (Mobile Co., Löding).

Tribe Lebiini.

In this tribe of plant loving Carabidæ the family reaches its highest development in Florida, the forty-three species recorded slightly exceeding the number given for New Jersey, and being often represented by a large number of records, showing their wide distribution within the state and comparative abundance. The development of the tribe is also shown by the number of species peculiar to the state and the tendency in other species to form races, some of which have not yet received names.

Tetragonoderus intersectus *Germar*. Not rare, Fort Capron, Enterprise, Cedar Keys (Schwarz); Lake Worth (Hamilton); Suwannee Springs, Pensacola, Belleair, Biscayne Bay (Slosson Coll., January–March); Pensacola, Oct. 11, Miami, Nov. 15 (Engelhardt); Lake City (Agric. Exp. Sta.); common, twenty beneath board in yard at Dunedin (Blatchley); Lakeland, at light, Nov. 9; Fort Myers, March 30, April 27, at light, Deep Lake, April 13 (Davis); Enterprise, April (Brownell); December, in lake shore debris; Clearwater, April 28, Titusville, Nov. 8, at light. Occurs in Georgia and Florida; not uncommon in Alabama, Mobile Co., July, August (Löding); and has also been reported from Kentucky. Varies in the extent of the yellow maculation, some of Mr. Davis' specimens from Deep Lake being immaculate. Mr. Löding has also found one specimen of *T. fasciatus* in Mobile Co., Ala.

Nemotarsus elegans *Leconte.* Cited but not seen by Mr. Schwarz; Archer (Koebele). Occurs in Illinois, Maryland, Virginia, Alabama (Mobile Co., under white oak bark in winter, Löding).

Loxopeza tricolor *Say.* Tampa, rare (Schwarz). Occurs commonly from District of Columbia northward to Canada. Mobile Co., Ala., two specimens (Löding). *L. grandis* has also been reported from Gulf States. Mr. Löding finds the latter in Mobile Co., Ala., but not common.

Lebia pulchella *Dejean.* Fort Capron, Tampa, rare (Schwarz). Occurs from Canada to Texas, usually not common anywhere. Mobile Co., Ala., July (Löding).

Lebia marginicollis *Dejean.* Not rare, St. Augustine, Crescent City, Bartow, Centerville (Schwarz); Lake Worth (Hamilton); Belleair, Jacksonville (January–March, Slosson Coll.); Sarasota, Bassenger, Sanford, Fort Myers, Lake Okeechobee, January, March, found by beating oak, etc. (Blatchley); Lakeland, Nov. 9, Punta Gorda, Nov. 14, Fort Myers, March 31, at light, April 24, April 1, sweeping in grassy meadow and low shrubs (Davis); Monticello, Oct. 4. Occurs in Peru, Brazil and North America to New Jersey. Mr. Löding has not so far found either this or the following variety in Alabama.

Lebia marginicollis var. **cyanea** *Dejean,* described from Cuba, has been regarded as a synonym perhaps incorrectly, and is included above as the records cover both forms.

Lebia viridis *Say.* Enterprise, Lake Harney, New Smyrna, St. Augustine (Schwarz); Belleair, Biscayne Bay (Slosson Coll., January–March); Lakeland, Nov. 7 and 9, Jacksonville, Nov. 3, Fort Myers, April 1 (Davis); Clearwater, April, May, Crescent City, Sanford (Van Duzee); Monticello, October, Gainesville, September, taken abundantly by sweeping vegetation. Extends from Maine to Guatemala. Mobile and Baldwin Co., Ala. (Löding).

Lebia viridis var. **rhodopus** *Schwarz.* Tampa, rare (Schwarz). Described as new species by Schwarz, treated as a variety by Horn, and apparently not found by recent collectors.

Lebia pumila *Dejean.* Enterprise (Castle and Laurent); Crescent City, April 22 (Van Duzee). Occurs from Maine to Georgia; Mobile Co., Ala., April, May, July (Löding).

Lebia lecta *Horn.* "Fla." (Ashmead); Key Largo (Schaeffer Coll.).

Described from Florida; apparently very rare, received from Gustav Beyer who says he found them in curled leaves following a fire which destroyed the weeds growing up among a heap of old cut branches.

Lebia viridipennis *Dejean.* Fort Capron, Enterprise, Cedar Keys, not rare (Schwarz); Lakeland, Nov. 10 (Davis); La Belle, April 27, at light; De Funiak Springs, Oct. 17. Occurs from Canada to Texas. Mobile Co., Ala. (Löding).

Lebia lobulata *Leconte.* Enterprise, rare (Schwarz). Known from Louisiana, Indiana, Virginia, District of Columbia, New Jersey; always rare. Mobile Co., Ala., November, under hickory bark (Löding).

Lebia ornata *Say.* Key West ? (Leng Coll.); Taylor Co. (Genung). Widely distributed in United States, common northward, apparently not so in Florida. Mobile Co., Ala., May, June (Löding).

Lebia collaris *Dejean.* Tampa, Enterprise, St. Augustine (Schwarz); Enterprise (Brownell). Occurs in Middle and Southern States. Mobile Co., Ala., September, October, November, on golden rod (Löding).

Lebia analis *Dejean.* Enterprise (Castle and Laurent), also (Brownell); Miami, March 10 (Brownell). Throughout northern and southern states, also in Indiana; Mobile Co., Ala., May, July (Löding).

Lebia fuscata *Dejean.* Cited but not seen by Schwarz; Belleair (Slosson); Jacksonville, Nov. 5. Occurs from Canada to Florida and Missouri. Not found in Alabama by Löding.

Lebia abdominalis *Chaudoir.* Enterprise, one specimen, Jupiter (Schwarz); Lake Worth, Biscayne Bay (Slosson Coll., January–March). Occurs in Georgia, District of Columbia, Texas, Missouri, Indiana; Mobile Co., Ala., rare, February, April (Löding).

Dianchomena scapularis *Dejean.* Enterprise, one specimen (Schwarz). Extends northward to New Jersey, westward to Dakota. Mobile Co., Ala., one specimen, October (Löding).

Aphelogenia vittata *Fabricius.* Jacksonville (Slosson Coll., January–March); Lakeland, Nov. 8 (Davis); "Fla." (Leng Coll.). Pennsylvania to Texas; Mobile Co., July (Löding).

Aphelogenia furcata *Leconte.* Tampa, rare, Crescent City, one specimen (Schwarz); Gainesville (J. R. Watson). Occurs from Canada to Florida and westward to California.

?**Lebia chloroptera** *Chaudoir* occurs in tropical regions including Brazil. Chaudoir gives Florida also but the statement is not recently confirmed.

Phlœoxena signata *Dejean.* Enterprise, Tampa, rare, Crescent City (Schwarz); Sanford, Jan. 16, one only, beneath bark of pine (Blatchley); Key West. Occurs in Gulf States, North Carolina, South Carolina, Georgia and Alabama; Mobile Co., under bark of oak and pine in winter (Löding).

Phlœoxena signata var. **nigripennis** n. var. Enterprise, Oct. 6, Oct. 16, Nov. 1 (Brownell). Differs from *signata* by the dark piceous head, immaculate testaceous thorax, immaculate black elytra.

Coptodera ærata *Dejean.* Key West ? (Morrison, two specimens in Leng Coll. received through Angell Coll.). Occurs in Alabama (Löding, June), Louisiana, Texas, Kentucky, Ohio, South Carolina, Middle, Western and Southern States.

Mr. Löding takes in Mobile Co., Ala., the following, not thus far found in Florida: *Dromius piceus* Dejean, January, February; *Axinopalpus biplagiatus* Dejean, May. These are therefore more or less likely to occur in northern Florida.

Euproctus trivittata *Leconte.* Capron (Bolter); Lake Worth (Dietz); Key West, Biscayne Bay (Schwarz). Described from Florida and thus far unknown elsewhere.

?**Callida purpurea** *Say.* Jacksonville (Slosson Coll., January–March). Occurs from New York to Georgia, and westward to Nebraska. This is the only Floridian record. Mobile, Ala., one specimen (Löding).

Callida fulgida *Dejean.* Fort Capron, Haulover, Enterprise (Schwarz); Enterprise (Castle and Laurent); Lakeland, Nov. 10, sweeping (Davis); Fort Myers, March 31, sweeping bushes near river; Green Cove Spring; Taylor Co., April, May (Genung); Pensacola, Oct. 11. Gulf States only, Georgia, Florida, Texas, Alabama; on scrub oak hunting larvæ of *Metachroma* (Löding).

Callida decora *Fabricius.* Enterprise, Tallahassee, common in winter under oak bark, in summer on cotton (Schwarz); Lake Worth (Hamilton); Enterprise (Castle & Laurent); Silver Springs, Nov. 25 (Engelhardt); Newberry, Nov. 19; La Grange, September, Lakeland, May 5 (Davis); Enterprise, April (Brownell); Sebastian, Aug. (Genung); Gainesville, September, October. Gulf States, extending into Mexico, northward to Iowa in Mississippi Valley. Mr. Löding does not mention this species but cites *punctata* as common in Alabama.

Callida striata *Casey.* Florida (locality unrecorded). Described in Memoirs, IV, p. 177, as differing from *viridipennis* in its narrower form, coloration, deeper striæ, more convex and subalutaceous intervals, relatively narrower base of the elytra and many other features. The color is described as black, the head and pronotum with rather obscure violaceous lustre, variegated with metallic green, of which a vitta parallel to and not very near the thoracic margin from apex to base is especially noticeable; elytra vivid green, gradually with feebly cupreous lustre broadly toward the sides; under surface metallic green, legs black.

Callida viridipennis *Say.* Orange Grove, May (Seifert); Haulover, Enterprise, Crescent City, St. Lucie (Schwarz); Lake Worth (Dietz); St. Augustine (Johnson); Enterprise (Castle & Laurent); Jacksonville, Biscayne Bay (Slosson Coll., January-March); Dunedin, Ormond, Arch Creek, Lake Okeechobee, March, April, found by beating oak (Blatchley). Mt. Vernon, Mobile Co., Ala., under white oak bark (Löding).

?**Philophuga viridicollis** *Leconte.* Jacksonville (Slosson Coll., January–March). The only Florida record for this Texan species.

Plochionus discoideus *Schaupp.* (Bull. Br. Ent. Soc., II, p. 86, 1880 = *dorsalis* Horn, 1882). Biscayne Bay, St. Lucie, on herbage (Schwarz); St. Augustine (Johnson); Lake Worth (Hamilton); Key West (Schwarz); Enterprise, April (Brownell); Key Largo (Beyer). Confined to Florida and Georgia.

Plochionus vittatus *Leconte.* Described from Florida, recently found near Mobile, Ala., Dec. 20, by H. P. Löding in larval nest of leaf rollers on American olive.

Plochionus amandus *Newman.* Described from Florida. Not recently recorded except in the view which regards the preceding two as varieties.

?**Plochionus pallens** *Fabricius* (= *bonfilsii* Dejean, *valens* Leconte). New Smyrna, one specimen (Schwarz); stated to be a variety and perhaps not synonymous with the Fabrician species, which appears to be a West Indian insect, distributed by commerce so that it has occurred at seaboard cities in Europe and America.

Plochionus timidus *Haldeman.* Enterprise, Haw Creek, each one specimen (Schwarz); Enterprise, April, a variety with elytra entirely black (Brownell). Extends northward to New Jersey, westward to California.

Pinacodera limbata *Dejean.* Lake Worth (Dietz). Extends northward to Connecticut, westward to Texas; Mobile Co., Ala., common (Löding).

Pinacodera platicollis *Say* var. **fuscata** *Dejean.* Haulover, Enterprise, St. Augustine, Crescent City, Indian River (Schwarz); Jacksonville (Castle and Laurent); Lakeland, Nov. 10, Ortega, September (Davis); Enterprise, October, November (Brownell); Taylor Co. (Genung); Jacksonville, Nov. 3, beating palmetto, Nov. 5; Lakeland, Nov. 8, beating oaks; beaten from large bunches of "Spanish Moss" (*Tillandsia usneoides* L.) at Dunedin, Lake Okeechobee and Ormond (Blatchley). The species extends north to New Jersey, west to Texas; the variety appears to be confined to the Gulf States.

Cymindis elegans *Leconte.* Enterprise, Oct. 12 (Brownell); "Mass. to Fla." (Horn); Crestview, Oct. 15 (Mutchler & Watson). The true *elegans* seems to be confined to the Gulf Strip.

?**Cymindis planipennis** *Leconte.* Suwannee Springs (Slosson Coll., January–March); Enterprise, Nov. 1 (Brownell). Occurs only in New Mexico and Kansas *fide* Horn. At least one species of *Cymindis* is taken by Mr. Löding in Alabama.

Apenes angustata *Schwarz.* Enterprise, St. Augustine (Schwarz); Lake Worth (Hamilton); Sebastian, August (Genung). Confined to Florida. Horn treated this erroneously as = *lucidula,* a more northern species from which it is distinguishable as stated by Schwarz.

Apenes sinuata *Say.* Enterprise, Crescent City (Schwarz); Lake Worth (Slosson Coll., January–March); Taylor Co. (Genung). Extends northward to New Jersey. An allied form, undescribed, which is, however, smaller and narrower, occurs in Texas. Mobile Co., Ala., June, November (Löding).

Apenes opaca *Leconte.* Tampa, in the pine woods, under sticks, rare (Schwarz); Naples (Slosson Coll., January–March). Confined to Georgia, Florida, and Alabama (one specimen, Mobile Co., (Löding). *A. parallela* of the Bahamas and Cuba is a similar species.

Eucærus varicornis *Leconte.* Fort Capron, Tampa, Crescent City (Schwarz); Lake Okeechobee, May (Davis). Florida, Alabama, Louisiana.

Pentagonica flavipes *Leconte* (= *Rhombodera pallipes* Leconte). Crescent City, Haw Creek (Schwarz); Taylor Co. (Genung); Enterprise (Brownell). Extends northward to New Jersey, westward to Arizona.

Onota floridana *Horn.* Lake Poinsett, Haw Creek, Biscayne Bay, concealed in leaves of Palmetto (Schwarz); Enterprise, Nov. 10, Nov. 17 (Brownell). Confined to Florida.

In addition to the above listed Lebiini, *Dromius atriceps* occurring in Georgia and Louisiana, probably is to be found, but there are no definite records.

Tribe Helluonini.

Helluomorpha ferruginea *Leconte.* Ormond, March 24 (Blatchley); six were secured beneath a pine log in open woods.

Helluomorpha præusta *Dejean.* Sand Point, Tampa, very rare, under old pine bark (Schwarz). Occurs also in Georgia.

Helluomorpha clairvillei *Dejean.* Pensacola, Charlotte Harbor (Slosson Coll. January–March); La Grange, September (Davis); near Pablo Beach, in an abandoned garden, Nov. 4. Occurs also in Georgia, where *H. nigripennis,* not known so far from Florida, is also found. Both species are found, rare, in Alabama by Löding.

Tribe Brachynini.

The definition of the species cited in this tribe is unsatisfactory and must perhaps remain so until comparison can be made with the types.

Brachynus alternans *Dejean*, larger than *fumans* and with strongly elevated costæ, is recorded by Blatchley and a similar species (*?deyrollei*) by Brownell. *B. alternans*, identified by Prof. H. C. Fall, is taken in Mobile Co., Ala., by Löding.

?**Brachynus americanus** *Leconte*, is also included by Blatchley only; St. Petersburg, Lake Okeechobee, Ormond, Dunedin, January, April, beneath cover at borders of ponds.

Brachynus fumans *Fabricius*. Enterprise (Castle and Laurent); Punta Gorda (Slosson Coll., January-March); (Sanford, Fort Myers, Sarasota, Lake Istokpogee, January, March (Blatchley); Everglade, May, June, July (Davis Coll.); Monticello, Oct. 4.

Brachynus quadripennis *Dejean*. Lake Worth (Hamilton); Biscayne Bay (Slosson Coll., January–March). Mobile Co., Ala. (Löding).

Brachynus cordicollis *Dejean*. St. Augustine (Schwarz); Lake Worth (Hamilton); Dunedin, Sanford, Sarasota, January, March (Blatchley); Punta Gorda, Nov. 16, under boards. Mobile Co., Ala. (Löding).

?**Brachynus pulchellus** *Blatchley*. Described from Indiana, occurs also in Florida, according to Blatchley: Sarasota, February, March. Determination is doubtful.

Brachynus lateralis *Dejean*. Common (Schwarz); all places collected, common (Blatchley); Enterprise, April (Brownell). Mobile Co., Ala., common (Löding).

Brachynus puberulus *Chaudoir*. Biscayne Bay (Slosson Coll., January–March).

Brachynus cyanipennis *Say*. Enterprise (Castle and Laurent); Silver Springs, Nov. 26 (Engelhardt); Punta Gorda, Nov. 13, Nov. 16, under board along roadside; Everglade, July (Davis Coll.); Fort Myers, April 26, under boards and rubbish at edge of pond.

No comparative distribution data are given in this tribe on account of the unreliability of the identification. It may be noted that Mr. Schwarz has committed himself in very few instances in this tribe. In addition to species named above Prof. Fall has identified among specimens taken near Mobile by Mr. Löding the following: *viridipennis, perplexus, medius, tomentosus*.

Tribe Chlæniini.

Chlænius herbaceus *Chevrolat*. Fort Capron, Sand Point, Lake Harney, Tampa (Schwarz); Jacksonville (Castle and Laurent); Enterprise

(Slosson Coll., January–March); Silver Springs, Nov. 25 (Engelhardt); St. Petersburg, Jan. 21, under boards along border of small lake (Blatchley); Lake Okeechobee, April 20 (Davis); Fort Myers, April 26, under boards and rubbish at edge of pond. Occurs also in Ga., Ala., and Mexico, Mobile Co., Ala., Feb. and March. (Löding).

Chænius erythropus *Germar.* Indian River (Schwarz); Jacksonville (Castle and Laurent); (Slosson Coll., Jan.–March); "Fla." (Blatchley); Punta Gorda, Nov. 15, in syrup trap at edge of fresh water meadow (Davis); Deep Lake, April 12, east of Great Cypress Swamp (Davis); Everglade, May, June, July (Davis Coll.); Enterprise, March (Brownell); Fort Myers, April 26, under boards and rubbish at edge of pond. Occurs from Ohio to Nebraska; also in New Jersey, southward to Louisiana. Mobile Co., Ala., January, February, Mexico, June (Löding).

Chlænius fuscicornis *Dejean.* Not readily separable from preceding; is given by Schwarz as occurring at Sand Point, Tampa, and Lake Worth and is also included by Blatchley. According to Schaupp, it occurs in Gulf States, Illinois and Missouri. Mobile Co., Ala., February, March (Löding).

Chlænius laticollis *Say.* Crescent City, Lake Poinsett, common (Schwarz); Lake Worth (Hamilton); Pensacola, Biscayne Bay, Atlantic Beach (Slosson Coll., January–March); "Fla." (Blatchley); Everglade, May, June, July (Davis Coll.); Enterprise, Dec. 12 (Brownell); Punta Gorda, under boards, Nov. 15; Fort Myers, April 26, under boards and rubbish at edge of pond; Monticello, Oct. 4. Extends northward to Conn., westward to Arizona. Mobile and Baldwin Co., Ala., common (Löding).

Chlænius æstivus *Say.* Enterprise, rare, St. Augustine, Gulf Hammock, Lake Poinsett, Tallahassee (Schwarz). This species and *C. diffinis* Chaudoir are more abundant in the Middle States. Mobile Co., April, July, not common (Löding).

?**Chlænius augustus** *Newman.* Described from Georgia, cited but not seen by Schwarz, taken once in wash-up in New Jersey, this species remains one of the least known. Mobile Co., Ala., January, February, very local (Löding). Mr. Löding takes *sericeus* also in Alabama.

Chlænius prasinus *Dejean.* Enterprise, Lake Poinsett (Schwarz); Dunedin, St. Petersburg, January, March, beneath boards at borders of ponds (Blatchley); "Fla." (Leng Coll.); Everglades, August. Occurs from Middle States west to Colorado and Texas. *C. solitarius* which is said to occur from Canada to Louisiana should be compared. Mobile Co., Ala., May, June, frequent (Löding).

Chlænius nemoralis *Say.* Tallahassee (Schwarz) Enterprise, March (Brownell, Castle and Laurent); Biscayne Bay (Slosson Coll., January–March); Dunedin, Sanford, Sarasota, January, March (Blatchley); Fort

Myers, April 26, under boards and rubbish at edge of pond. A common species from Canada to Texas. Mobile, Baldwin Co., Ala. (Löding).

Chlænius tricolor *Dejean.* St. Augustine (Schwarz); Enterprise, March (Brownell). Common east of Rocky Mountains. Mobile, Baldwin Co., common (Löding).

Chlænius floridanus *Horn.* Lake Worth (Dietz); Belleair (Slosson Coll., January–March); Sarasota, March 4 (Blatchley); Everglade, July (Davis Coll.); "Fla." (Leng Coll.). Described from Florida.

?**Chlænius pennsylvanicus** *Say.* Tampa, Enterprise, rare (Schwarz). "Occurs principally in northern states and Canada" (Horn).

The four species last named are similar in size and color.

Chlænius circumcinctus *Say* (*perplexus* Dej.). Fort Capron, Enterprise, Tampa, Crescent City (Schwarz); Miami (Slosson Coll., January–March); Arch Creek, March 21, one only (Blatchley); Fort Myers, April 26, under boards and rubbish at edge of pond; Lake Okeechobee, April 20, under dry grass, in humus at edge of lake. Occurs in Gulf States and Cuba, Mobile Co., Ala., May, June, rare (Löding).

Chlænius maxillosus *Horn.* Fort Capron, Lake Harney, two specimens (Schwarz); Everglade, April 7 (Davis); Everglade, May, June, July, common (Davis Coll.); "Fla." one specimen (Brownell). It is interesting to note that this species described from specimens found by Hubbard and Schwarz, and always considered rare, should be missing in northern Florida records but found common at Everglade in summer by Mr. Davis' collectors. It appears to be confined to the southern part of the peninsula, a distribution so restricted as to contrast sharply with that of the next.

Chlænius niger *Randall* var. **ludoviciana** n. var. The following localities are given for *C. niger,* all however, are believed to belong to the variety: Fort Capron (Schwarz); Lake Worth, Biscayne Bay (Slosson Coll., January–March); Jacksonville (Castle and Laurent) Mobile Co., Ala., July (Löding). The species extends from Newfoundland to the great Zapata swamp on the southern coast of Cuba and westward to Iowa, Nebraska, but varies greatly in its extended range. The type came from New England, the Newfoundland specimens differ, but not so much as those from Louisiana, Florida, and Cuba, in which the thorax is broader and shorter, the elytral sculpture less pronounced, and the size larger. The type of the new variety is in my collection, labelled Louisiana, and was obtained from the Luetgens collection.

Black, above and beneath, antennæ and mouth parts slightly paler, head and thorax shining, elytra dull, densely punctate and clothed between the striæ with decumbent hair. Head finely punctulate, with two irregular and vague grooves between the eyes, thorax with very large punctures in front, on the two sides of the disk and beside the median line, with a cluster of punctures in each hind angle; thorax much wider than long, vaguely depressed along median line and each side of the base. Length 15 mm.

Chlænius impunctifrons *Say.* Lake Poinsett (Schwarz). Canada to Texas (Horn). Mobile Co., Ala., March, April, not uncommon (Löding).

Chlænius tomentosus *Say.* Centreville (Schwarz); Jacksonville (Castle and Laurent). Nearly everywhere east of Rocky Mts. (Horn). Mobile, Baldwin Co., Ala., common (Löding).

Anomoglossus emarginatus *Say.* Tampa, one specimen, St. Augustine, Crescent City (Schwarz). Canada to Kentucky (Horn). Mobile Co., Ala., common (Löding). An allied species, *A. amœnus,* occurs but appears to be rare in Georgia.

Anomoglossus pusillus *Say.* Haw Creek, Jan. 14, 1896 (Schwarz). A specimen found at Fort Myers, April 26, 1913, under boards and rubbish at edge of pond, is doubtfully referred to this species. Horn gives the distribution as Massachusetts to Illinois. Mobile Co., Ala., not common, March (Löding).

Mr. Löding takes *Brachylobus lithophilus* in Mobile Co., Ala., but so far there is no record of its occurrence in Florida.

Group *Oödes.*

The remarkable inconstancy of the setigerous punctures in Oödes causes some doubt of the propriety of including them in the tribe Chlæniini. The rarity of one of the genera associated with Oödes in forming the group by Horn has however prevented a careful study and the classification is therefore reluctantly left as it stands in his Genera of Carabidæ.

Lachnocrepis parallelus *Say.* Fort Capron, Haulover, Biscayne Bay, rare (Schwarz); Biscayne Bay, January (Slosson Coll.); Fort Myers, April 11, in grassy meadow with small pines. Extends northward to Canada, westward to Missouri.

Anatrichis minuta *Dejean.* Fort Capron, Cedar Keys, Tampa, St. Augustine, Sebastian River (Schwarz); Lake Worth (Hamilton); Biscayne Bay, January (Slosson Coll.); Fort Myers, April 1, at light (Davis). Extends northward to District of Columbia, west to Texas, Indiana, Missouri, nowhere common.

Anatrichis picea *Horn.* Arch Creek, 10 miles north of Miami, March 21 (Blatchley); Everglade, May (Davis Coll.). Described from Florida.

Oodes amaroides *Dejean.* Fort Capron, Enterprise, Tampa, St. Augustine (Schwarz); Arch Creek, Dunedin, January, April (Brownell); Lake

Okeechobee, April 30, under dry grass, in humus at edge of lake (Davis); Monticello, Oct. 4. Extends northward to New York, west to Texas and Kansas. Mobile Co., Ala., subaquatic (Löding). Reported also from Cuba.

Oodes americanus *Dejean.* Sand Point, Fort Capron (Schwarz); Lake Worth (Hamilton, Slosson); Belleair (Slosson Coll., January–March); Lake Okeechobee, April 29 and 30, shore of lake (Davis); Monticello, Oct. 4. Extends northward to New York, west to Indiana. One of Mrs. Slosson's specimens from Biscayne Bay has been determined, probably by Liebeck, as *O. fluvialis,* a very closely allied species. Mr. Löding has found one specimen of *O. americanus* in Mobile Co., Ala.

Oodes 14-striatus *Chaudoir.* St. Lucie, Crescent City, rare (Schwarz); Enterprise (Castle and Laurent); Lake Worth (Slosson Coll., January–March); La Belle, Deep Lake, April (Davis); Everglade, May, June, July (Davis Coll.); Allen River to Deep Lake, April 14, in a grassy place with thistles in patches. Known from Louisiana, Texas, Indiana and Alabama (Mobile Co., scarce, subaquatic, Löding).

Oodes (Stenous) cupræus *Chaudoir.* St. Augustine, Lake Harney, Lake Poinsett, Fort Capron (Schwarz); Biscayne Bay (Slosson Coll., January–March); Arch Creek, one only, March 21 (Blatchley). Other records for this species are western, viz.: Indiana, Missouri, Kansas, Texas, New Mexico, except Mr. Löding's Alabama record (Mobile Co.).

Oodes (Stenous) lecontei *Chaudoir.* Fort Capron Enterprise, Tampa, Sebastian River (Schwarz); Lake Worth (Hamilton); Miami (Slosson Coll., Jan.–March); Arch Creek, Dunedin, Lake Okeechobee, February, March (Blatchley); Lake Okeechobee, April (Davis); Everglade, May, June, July (Davis Coll.); Fort Myers, April 20, under boards and rubbish at edge of pond. The abundance is this species in southern Florida is noteworthy. Outside the state there are records from Louisiana, Alabama (Mobile Co., July, rare, Löding) and New Jersey (?).

Evolenes exaratus *Dejean.* Tallahassee (Schwarz). "Fla." (Leng Coll.). Recorded also from Georgia, Alabama, and District of Columbia. The allied *E. impressa* is known from Louisiana. They are said to resemble *Amara musculus* and the paucity of records may result partly from being confused therewith.

Tribe Harpalini.

Agonoderus infuscatus *Dejean.* Not rare (Schwarz); Lake Worth (Hamilton); Biscayne Bay, Jacksonville (Slosson Coll., January–March); Lake City (Agl. Exp. Sta.); Sarasota, Sanford, Fort Myers, March, beneath dead crayfish (Blatchley); Everglade, May, June, July (Davis Coll.); April, at light, La Grange, September (Davis); Sebastian, Jacksonville (Genung); Enterprise, Dec. 12, in lake shore debris (Brownell); Sanford, May; Clearwater, April 28; La Belle, April 27, at light. Fort Myers, March 31, at light, Nov. 15, at light, Florida (Casey). An abundant species in eastern United States, extending north to New Jersey; west to Texas. Mobile Co., Ala., common (Löding).

Agonoderus testaceus *Dejean.* Common (Schwarz); Jacksonville (Slosson Coll., January–March); Sarasota, March 1, one only (Blatchley); Punta Gorda, Nov. 12 (Davis). Extends northward to New York, west to Indiana. Mobile Co., Ala., common (Löding). Mr. Löding also lists *A. indistinctus* as rare in Mobile Co., Ala.

Agonoderus pauperculus *Dejean.* Crescent City (Schwarz). Recorded from District of Columbia, New Jersey, Indiana, and more common in Southern States.

Gynandropus hylacis var. **elongatus** *Leconte.* Fort Capron, Tampa, St. Augustine, Jupiter, Indian River (Schwarz); Enterprise, December (Brownell). Extends northward to Staten Island, New York, where it is found under pine bark, west to Indiana. Mobile Co., Ala., January, two specimens (Löding).

Harpalus viridiæneus *Beauvois.* Lake Worth (Slosson Coll., January–March). A common species northward, extending to Canada, for which there is only Mrs. Slosson's record in Florida.

Harpalus caliginosus *Fabricius.* St. Augustine (Schwarz). This is the only record for this, one of the most widely distributed of ground beetles, covering practically all the United States. Common in Mobile Co., Ala. (Löding).

Harpalus pennsylvanicus *De Geer.* Not rare (Schwarz); St. Augustine (Schwarz); Pablo Beach, September, Lakeland, Nov. 7 (Davis); Gainesville, Monticello, De Funiak Springs, Florida (Casey). Extends northward to Connecticut westward to Indiana. Common in Mobile Co., Ala. (Löding).

Harpalus compar *Leconte.* Pensacola (Slosson Coll., January–March). Fort Myers, March 30, April 22, at light; Everglade, April 14; at light, Ortega, South Jacksonville, September (Davis); Everglade, May, June, July (Davis Coll.); Enterprise, October (Brownell); Sanford, May; Clearwater, April 28; Lakeland, May, in level pine land. Equally distributed with the preceding and usually treated as a variety thereof. Mobile Co., Ala. (Löding).

Harpalus herbivagus *Say.* St. Augustine (Schwarz). Abundant in New Jersey, and is even reported from Newfoundland.

Harpalus nitidulus *Chaudoir.* Haulover, Enterprise, rare (Schwarz);

Lake Worth (Hamilton); Lake Okeechobee, May (Davis). Mobile Co., Ala.? (Löding).

It will be noted how poorly the genus *Harpalus,* so commonly found in more northern regions, is represented in Florida. The reverse will be found in the following genus, which both in species and individuals, seems to abound, forming a characteristic feature of every Florida collection, at least from the southerly part of the state.

The genus *Hemisopalus* Casey (type *Selenophorus opalinus* Lec.) differs from *Selenophorus* by the more or less depressed dorsal surface, by the very slender hind tarsi, nearly as long as the tibiæ, and other characters, including the frequently opalescent elytra; it includes of previously described Floridian species, *opalinus, gagatinus, iripennis* and *subtinctus,* besides the following described by Casey as new, viz.: (1) *delumbis* Csy, Lake Worth, said to be allied to *subtinctus* which Casey did not have for comparison; (2) *depressulus* Csy, Lake Worth, said to be closely allied to *iripennis,* not represented in Casey's collection; (3) *vigilans* Csy, Florida, placed next to *depressulus.* As in some other instances, the description of these species as new seems to result from Col. Casey's inability to make the characters observed in Floridian specimens coincide with those described from more northern specimens; he does not record as Floridian the species given below his own species apparently replacing them, rather than constituting additions to the list. It may therefore be eventually necessary to use his names in place of those we have cited, perhaps in varietal or trinomial form, but not probably as pure additions to the list.

Selenophorus palliatus *Fabricius* (including *S. stigmosus* Leconte, treated as a synonym in Horn's revision of the genus). Enterprise, St. Augustine, Lake Worth, Buck Key, not rare, frequently attracted by the light (Schwarz); Biscayne Bay (Slosson Coll., January–March); Lake City (Agl. Exp. Sta.); Sanford, Jan. 13, one only, beneath board in field (Blatchley); Lakeland, Nov. 7 (Davis); Everglade, May, July (one only) (Davis Coll.); Paola, Jacksonville, Sebastian, Aug. (Genung); Enterprise April, October, November, December (Brownell); Key West (Angell. Coll.); Sanford, May; Clearwater, April 28, Fort Myers, March 30, April 22, at light. Extends north to Georgia, west to Arkansas and Texas. A closely allied, apparently unnamed form, extends to Lower California. Common in Mobile Co., Ala. (Löding).

Selenophorus chokoloskei n. sp.

Piceous, legs pale, upper surface shining, bronzed. Thorax equally wide at base and apex, sides regularly arcuate, widest a little before the middle, hind angles distinct but obtuse and rounded, basal impressions almost obsolete. Elytra a little wider than the thorax, oblong oval, sinuate at tip, finely striate, striæ 2–5–7 each with small but distinct punctures. Length, 6.75 to 7.50 mm.

Chokoloskee, April 8; Everglade, April 6, April 7, in truck garden and grassy lowlands (Davis). This species while as large as small specimens of *S. palliatus* and similarly bronzed, differs by the dorsal series of punctures being small but distinct, its depressed form, the more equally rounded sides of the thorax and the very feeble basal impressions. It may possibly prove identical with one of the numerous Cuban species but cannot be successfully compared with the brief descriptions given for them, nor could it be found in the Gundlach collection.

Selenophorus pedicularius *Dejean.* Tortugas, Buck Key (Schwarz); Lakeland, May 6, Deep Lake, April 13, Fort Myers, April 1, at light, Everglade, April, May (Davis). Horn gives the distribution as Middle States to Kansas, Florida, Arizona. He included *troglodytes* as a synonym.

Selenophorus fatuus *Leconte* (*S. excisus* Lec. included as a synonym). Biscayne Bay (Slosson Coll., January–March); Southern Florida (Dr. Palmer, Leconte); Key West (Angell Coll.); Key West, Big Pine Key, September (Davis); Everglade, June (Davis Coll.). Confined to Gulf States. Rare in Mobile Co., Ala. (Löding). *S. mustus* Casey (Mem. Col. V. Oct. 1914) has been described from Biscayne Bay as near *fatuus.*

Selenophorus iripennis *Say.* Lake Worth, Biscayne Bay, very common under boards and rubbish (Slosson Coll., January–March); Enterprise, April, October (Brownell); Lakeland, Nov. 7; Fort Myers, March 30, at light, April, November, Gainesville, Sept. 26. Extends northward to New Jersey, west to Illinois and Texas. Rare in Mobile Co., Ala. (Löding).

Selenophorus subtinctus *Leconte.* Fort Capron, Sand Point, very rare (Schwarz). This species is very close to the preceding and possibly some of the records there cited should be placed here. It was described from Louisiana.

Selenophorus opalinus *Leconte.* Enterprise, rare (Schwarz); Wisconsin and Michigan to Florida (Horn); Key West (Angell Coll.); Enterprise, November (Brownell); Everglade, April 15, in syrup trap, April 6, in grassy meadow with low bushes, April 5, in truck garden, April 10, at light, May, June, July, the most abundant Carabid beetle at Everglade (Davis Coll.); Fort Myers, March 30, at light. If the identifications are correct, this species extends north to New York and west to California, but there seems to me some question about the specific identity of the forms included. Common in Mobile Co., Ala. (Löding).

Selenophorus gagatinus *Dejean.* Enterprise (Schwarz); Lake Worth (Slosson Coll., January–March) Massachusetts to Texas (Horn). Accordinging to Mr. Schaeffer, who has studied this genus closely, some of the records I have credited to *S. opalinus* may belong here.

The genus *Celiamorphus* Casey though not differing by any decisive structural characters is proposed for the small elliptical subdepressed species allied to *ellipticus*, and it is pointed out that in their opaque integuments, at least in the female, they also differ; *fossulatus, ovalis* and *ellipticus* of this list are included.

Selenophorus fossulatus *Dejean.* Fort Capron, Polk Co. (Schwarz); Lake Worth (Hamilton); Atlantic Beach, Belleair (Slosson Coll., January–March); Tampa, Nov. 23 (Engelhardt); Sarasota, Feb. 15–March 2, common under dry cow dung in pine woods (Blatchley); Enterprise, April, December (Brownell); Taylor Co., April, May (Genung). Confined to Georgia, Florida and Alabama (Baldwin Co., May 20, rare, Löding).

Selenophorus ovalis *Dejean.* Tampa, very rare, St. Augustine (Schwarz); Lakeland, Nov. 8 (Davis), running in sandy field between patches of Dog-Fennel. Confined to Georgia and Florida. Included in Smith's New Jersey List, probably in error, for the next species is similar and is the one that extends northward.

Selenophorus ellipticus *Dejean.* Crescent City (Schwarz); Jacksonville (Castle and Laurent); Pensacola (Slosson Coll., January–March); Pensacola, Oct. 11. Middle States to Georgia and Texas. Not uncommon in Mobile Co., Ala., March (Löding).

There are thus eleven species of *Selenophorus* recorded for Florida against five for New Jersey, one of them noted as the most common Carabid at Everglade, supporting the prevalence of the genus in the southern part of the peninsula, and suggestively comparable with its development in Cuba.

Stenolophus conjunctus *Say.* Crescent City, St. Augustine (Schwarz). Occurs over a wide range, from the Atlantic to the Pacific ocean, northward to New Jersey. Common in Mobile and Baldwin Co., Ala. (Löding).

Stenolophus spretus *Dejean.* Fort Capron, Enterprise, Tampa, Jupiter, not rare (Schwarz); Sarasota, Arch Creek, March (Blatchley); Everglade, April 11, at light. Extends northward along the Atlantic Coast to New Jersey.

Stenolophus plebejus *Dejean.* Tampa, one specimen (Schwarz); Little River, February, March (Blatchley, Schaupp). Same range as preceding, also Indiana.

Stenolophus ochropezus *Say.* Enterprise (Schwarz); Biscayne Bay, Jacksonville (Slosson Coll., January–March); Sarasota, Little River, Lake Okeechobee, January, March, beneath cover in damp places (Blatchley); Lakeland, Nov. 9 (Davis); Florida (Casey); Gainesville, Sept. 26. Same range as preceding. Common in Mobile and Baldwin Co., Ala. (Löding).

There is still an unidentified specimen of *Stenolophus* in Mrs. Slosson's collection, and probably more of this and of the two following genera in other collections; possibly these small and obscure insects are also to some extent overlooked by collectors, for the records seem relatively poorer for them than for other genera.

Acupalpus longulus *Dejean.* Dunedin, Lake Okeechobee, Sanford, Jan. 24–March 30, by sifting (Blatchley); Key Largo (Beyer ?); Sebastian, August (Genung). Known also from Georgia.

Acupalpus flavilimbus *Leconte.* Tampa (Schaupp Coll.). Described from Georgia.

Acupalpus rectangulus *Chaudoir.* "Fla." (Schwarz). Recorded from Louisiana, Georgia, South Carolina, District of Columbia.

Bradycellus rupestris *Say.* "Fla." (Brownell, Slosson Coll., January–March). Widely distributed in United States. Mobile Co., Ala., June (Löding).

Bradycellus tantillus *Chaudoir.* Biscayne Bay, Jacksonville (Slosson Coll., January–March); "Fla." (Blatchley); Key Largo (Roberts Coll.). Widely distributed in United States. Common in Mobile Co., Ala (Löding).

Bradycellus nigriceps *Leconte.* "Fla." (Blatchley). Extends northward to New Jersey.

Anisodactylus lödingi *Schaeffer.* St. Augustine, Nov. 8 (Engelhardt); Everglade, April, June, July (Davis Coll.); Lakeland, May 7, La Belle, April 27 (Davis); Newberry, under rubbish and cow dung, Nov. 18, Titusville, Nov. 8. Described from Alabama, closely allied to the northern *A. agricola.* Mr. Löding says it is subaquatic and rare in Mobile Co., in February, March.

Anisodactylus rusticus *Dejean.* Jacksonville (Slosson Coll., January–March); Lake City, February (Agl. Exp. Sta.); Ormond, April 1 (Blatchley). Occurs commonly everywhere east of Rocky Mts. The Florida insect is usually cited as *A. merula* which is very similar but has dentate humeri instead of the simple ones of *A. rusticus,* and cannot therefore be a synonym as stated by Horn. *A. rusticus* is common in Mobile Co., Ala. (Löding).

Anisodactylus merula *Germar.* St. Augustine, Lake Worth, Enterprise, Jacksonville, not rare (Schwarz); Sanford, Nov. 27 (Engelhardt); Lakeland, Nov. 8, Newberry, Nov. 19 (Davis); Gainesville, Sept. 26, Pensacola, Oct. 10, De Funiak Springs, Oct. 17, Monticello, Oct. 4, Florida (Casey); St. Petersburg, April 28, La Grange, May and September, Everglade, August (Davis Coll.); *A. rusticus* and *A. merula* are placed by Casey in *Triplectrus* Lec.

Anisodactylus lætus *Dejean.* Sarasota, March 3, beneath dead crawfish in old pond slush (Blatchley); Clearwater, April 28; Fort Myers, March 31, April 23, at light. Extends northward to New Jersey, west to Texas. Common at light in Mobile Co., Ala. (Löding).

Anisodactylus agilis *Dejean.* Haulover, Pensacola, Jacksonville, Crescent City (Schwarz); Ormond, Lake Worth, Jacksonville (Slosson Coll., January–March); Daytona, Nov. 19 (Engelhardt); Lake City, Oct. (Agl. Exp. Sta.); Fort Myers, April 1, at light; Everglade, April 7, Pablo Beach, Ortega, September (Davis); Enterprise, September, October (Brownell); Sebastian, August (Genung); Key West (Angell Coll.). Occurs also in Georgia.

Anisodactylus nitidipennis *Leconte.* Haulover, Enterprise, Cedar Keys, not rare (Schwarz); St. Augustine (Johnson); Lake Worth (Hamilton); Biscayne Bay (Slosson Coll., January–March); Fort Myers, Nov. 12; March 30, at light, April 22, at light; Lakeland, Nov. 8, April 22; Lake Okeechobee, April 29; Everglade, April 6, grassy meadow with low bushes. Extends north to District of Columbia and Indiana. Very common at light in Mobile Co., Ala (Löding).

The three species last named are placed in *Anisotarsus* Chaudoir by Casey and in addition to them he has recently (Memoirs V, Oct., 1914) described three other species from Florida, viz.; *A. floridanus* Casey, "Florida," allied to *terminatus; A. cephalus* Casey, "Florida"; and *A. tenuitarsis* Casey, "Lake Worth (Kinzel)." These, from the descriptions given, seem close to the specimens listed above as *agilis* and *nitidipennis.* The latter, described from a single specimen from Georgia by Leconte, Casey is unable to recognize among his material, though he says there can be little doubt that it belongs near *cephalus* and *tenuitarsis.* The name *agilis* which has been heretofore used by Schwarz, and others for Florida specimens, Casey restricts to specimens from Missouri and Texas, and considers it not as closely related to *nitidipennis* as indicated by Leconte. It would therefore not increase the list to include the three species he has described, but would substitute the names he has given for those heretofore in use, a course I am not at present willing to adopt.

Anisodactylus terminatus *Dejean.* Ormond, March, April (Blatchley). Occurs northward in District of Columbia, New Jersey, Indiana.

The tribe Harpalini has thus thirty-nine representatives known to occur in Florida, to which number two (*Tachycellus nebulosus* Lee, known from Georgia to Texas, and *Discoderus parallelus* Hald, known from Pennsylvania to New Mexico), might be added as probable, but even so the total would be small as compared with the sixty-eight recorded from New Jersey.

Subfamily Pseudomorphinæ.

There are no Florida records known, but as *Pseudomorpha excrucians* is known to occur in Georgia and Alabama (Orchard, Mobile Co., Ala., rare, Löding), there is some likelihood of it being found in northern Florida.

59.7.55H.(729.3)

Article XX.— ON *HETERANDRIA ZONATA* SP. NOV. AND *HETERANDRIA VERSICOLOR* (GÜNTHER) FROM THE ISLAND OF SANTO DOMINGO.

By John Treadwell Nichols.

On a recent entomological collecting trip Mr. Frank E. Watson, of the American Museum, obtained a ♂ and ♀ adult and three immature specimens of *Heterandria versicolor* (Günther) from the San Juan River (freshwater) at Samana, Santo Domingo. He also obtained 5 adult ♂ and two immature fishes of the genus from the freshwater creek near the railroad station at Sanchez. The immature specimens are too small for satisfactory study. The adults differ from the *versicolor* ♂ mentioned above strikingly in color and significantly in form, and are described as new.

Heterandria zonata sp. nov.

I have selected as type a specimen 26 mm. long to base of caudal. Head 3.4 in this measure; depth 3.6; eye 3, in head; snout 4; width of mouth, 4; depth caudal peduncle, 1.6; pectoral, 1.5; ventral, 1.8; anal, 1; longest dorsal ray, 1.6; caudal 1. Scales 29. Dorsal 8. The caudal peduncle is elongate and compressed, mouth very small, eye large, caudal about even, a single row of somewhat obliquely pointed, more or less broad and compressed teeth in the jaws. Dorsal origin equidistant from base of caudal and border of preopercle. Anal origin nearer tip of snout than base of caudal by a distance equal to snout, when depressed not reaching caudal by a distance about two and one half times eye. Color in spirits pale, the scales outlined by narrow dark lines, indications of a lengthwise dark streak in the middle of the side. Three rather broad black bars on the side under the dorsal. A narrow black streak on the mid-dorsal line and mid-ventral line behind the anal. Dorsal with a broad black margin, caudal with an ill-defined dark vertical streak centrally, other fins plain.

The four other specimens (paratypes) range in length to base of caudal from 19 to 25 mm. All have the anal origin decidedly nearer snout than caudal, and 4 or 5 broad black bars on the sides. These characters alone show them to be distinct from the *versicolor* here described.

Heterandria versicolor (*Günther*).

The ♂ is 23 mm. long to base of caudal. Head 3.4 in this measure; depth 4; eye, 3, in head; snout, 5; width of mouth, 3.5; depth caudal peduncle, 1.6; pectoral 1.6; ventral, 1.5; anal, 1; longest dorsal ray, 1.7; caudal, 1.2. Scales 28. Dorsal 8.

The caudal peduncle is elongate and compressed; mouth small vertical; eye large; caudal slightly rounded. A single row of teeth in jaws, somewhat compressed and with oblique points. Dorsal origin equidistant from preopercular margin and base of caudal. Anal origin equidistant from front of eye and base of caudal, not reaching caudal when depressed by a distance slightly less than twice eye. Color in spirits pale, the scales outlined by narrow black lines and a narrow black line in the center of the side. Dorsal marked with dusky terminally, most strongly on the posterior rays, and a dusky mark towards the base of the posterior rays. A short black stripe in the center line of the peduncle above and below.

The ♀ is 31 mm. long to base of caudal. Head 3.6 in this measure; depth the same. Eye 2.8, in head; snout 4; depth caudal peduncle 1.7; pectoral, 1.5; ventral 1.9; longest anal ray, 1.5; dorsal ray, 1.7; caudal 1.3. Scales 28. Dorsal 8. Anal 8. Caudal even. Color resembles that of ♂ but dusky terminal area on dorsal is lacking, and there is a faint vertical dark streak across the center of the caudal.

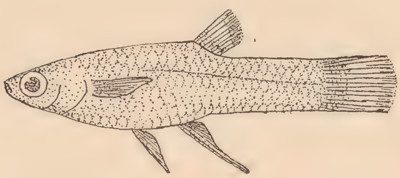

Fig. 1.

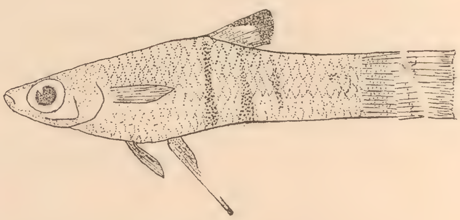

Fig. 3.

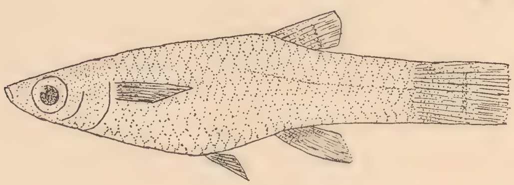

Fig. 2.

Fig. 1. *Heterandria versicolor* (Günther). ♂.
Fig. 2. *Heterandria versicolor* (Günther). ♀.
Fig. 3. *Heterandria zonata* sp. nov. ♂.

59.57.72D

Article XXI.— EXPERIMENTS WITH *DROSOPHILA AMPELOPHILA* CONCERNING NATURAL SELECTION.

By Frank E. Lutz.

Most of the many discussions concerning Natural Selection have not only been purely theoretical but have postulated that the characters under consideration are in each case heritable ones. As a matter of fact Natural Selection is one problem and Inheritance another; combined they form an important part of a certain theory of evolution but one may be studied separately just as well as the other. Natural selection as applied to *Homo sapiens* has been carefully investigated for some time by the life insurance companies and in the only way in which such problems can be profitably studied — by the analysis of the death rate in populations. There have also been a few actuarial papers concerning lower organisms. Some of the more important of these have been reviewed by Harris.[1]

Ordinarily we think of natural selection as changing the average by killing off mainly those creatures which have a given characteristic or which have it in a given degree. Thus if very heavy men tend to die at an earlier age than those who are not so heavy natural selection is acting to decrease the mean, or average, weight of the population. However, natural selection may tend to kill off both the very heavy and the very light men in such proportions that the mean would remain the same. Natural selection is, nevertheless, acting and manifests itself by the decreased variability of the surviving population, it being largely made up of those who are neither heavy nor light. It is conceivable that natural selection might favor the very heavy and the very light but kill off first those of medium weight. In that case the average weight of the population might remain the same but the variability of the surviving population would be greater than that of the original one or of the one which perished.

Finally, the weight, in itself, of the men might have nothing to do with natural selection and we could suppose that height, in itself, had nothing to do with natural selection but if those men who were short and heavy as well as those who were tall and light died earlier than the rest of men natural selection would be acting. The basis of its action would not be weight or stature but the correlation between the two and the effect would be to increase the positive correlation. It is easy to see that there might be cases

[1] J. Arthur Harris. 1911. 'The Measurement of Natural Selection.' Popular Science Monthly, LXXVIII, pp. 521–538.

in which selection acts on the basis of correlation in such a way that the surviving population has a lesser positive or a greater negative correlation than those which perished. Furthermore Pearson [1] has shown that selection of the mean and variability of a character influences very markedly the correlations between this and other characters.

The result of these considerations is that we are forced to take a wider view of selection than has ordinarily been done. If that portion of the population which perishes differs significantly in either mean, variability or correlations from that portion which survives we must admit that natural selection has been effective. Furthermore, although it is relatively easy to demonstrate by statistical methods whether or not selection has influenced a given character, it is impossible in the present stage of science to determine just what the basis was upon which selection worked. If characters A, B and C are correlated in their variabilities, selection acting directly upon the mean of character A would change not only the means and variabilities of characters B and C but the correlations among the three characters. If we studied only B and C we would find that selection had acted but might be at a loss to explain its action. The only thing to do, in a case as complicated as is the problem of selection, is to accumulate facts bearing on the subject, keeping the various hypotheses in mind and leave it to future generations to find out the right.

The present paper concerns the Pomace Fly, *Drosophila ampelophila.* There are two sets of experiments. In one, carried on at the Carnegie Institution's Station for Experimental Evolution, the flies were reared at a temperature kept rather close to 20° C. and the adults were given water but no food. In the other, carried on at the American Museum of Natural History, the flies were reared under normal, *i. e.* uncontrolled, temperature conditions and the adults were carefully fed. The only unnatural condition in the second set of experiments, as far as could be determined, was that the adults were not allowed to mate. In both sets of experiments the relation of physiological characters, the duration of the embryonic periods, to the duration of adult life was studied and in one of them two anatomical characters also were studied. On account of the practical difficulty of determining the exact time of hatching, the egg and the larval periods were combined in the records.

There are two ways of determining whether or not selection acts (directly or indirectly) upon the actual size of a character: we may compare the mean of the character among those which perished with that among those which survived or we may calculate the correlation between the size of the character and the ability to survive. Both methods are used here.

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[1] Pearson, K. 1902. 'On the Influence of Natural Selection on the Variability and Correlation of Organs.' Phil. Trans. Royal Soc. London, Series A, Vol. 200, pp. 1–66.

	Normal		Starvation	
	Males	Females	Males	Females
Egg-larval Period	−0.1270±0.0420	−0.1609±0.0405	+0.0535±0.0624	−0.1133±0.0598
Pupal Period	−0.1392±0.0418	−0.2525±0.0389	−0.0457±0.0625	−0.0274±0.0605
Length Post. Cell			+0.1325±0.0626	+0.2536±0.0573
Breadth Wing			+0.3176±0.0573	+0.1231±0.0604

Table 1. Correlations between the Length of Adult Life and other characters.

From Table 1 we see that in the set which were allowed to die normally there is a negative correlation in each sex between the length of adult life and the duration of the embryonic periods — those individuals which completed their embryonic periods quickly, probably because they were those whose physiological processes were working well, tended to have long lives. In all cases the cofficient of correlation is at least three times as great as its probable error so that the results may be considered statistically trustworthy. The same thing is seen from Table 2 in which it is shown that

		Normal		Starvation	
		Males	Females	Males	Females
Egg-larval Period	General Population	7.3560±0.1015	7.3764±0.0922	6.5353±0.0422	6.4266±0.0328
	Short lived	7.9837±0.1525	7.6905±0.1185	6.4929±0.0384	6.5434±0.0565
	Long lived	6.7480±0.1240	6.8211±0.1377	6.5750±0.0688	6.3394±0.0373
Pupal Period	General Population	5.6440±0.0350	5.3346±0.0306	6.2026±0.0297	5.8145±0.0334
	Short lived	5.8211±0.0338	5.4881±0.0359	6.1964±0.0393	5.8396±0.0388
	Long lived	5.4724±0.0490	5.0632±0.0511	6.2083±0.0441	5.7958±0.0505
Length of Post. Cell	General Population			45.9643±0.1410	52.4091±0.1345
	Short lived			45.5741±0.2218	51.8137±0.2086
	Long lived			46.3276±0.1715	52.8429±0.1674
Breadth of Wing	General Population			31.5179±0.1095	35.3595±0.0989
	Short lived			30.9444±0.1652	35.0098±0.1522
	Long lived			32.0517±0.1282	35.6143±0.1264

Table 2. Means. In the "normal" experiments the "short-lived" adults died before they were 32.5 days old and in the starvation experiments they died before they were 66 hours old. The "long-lived" ones survived these respective ages.

the population which lived less than 32.5 days as adults had markedly longer embryonic periods not only than those with longer adult lives but than the general population.

The results of the starvation experiments were not what I expected them to be for I had thought that those larvæ which fed for a long time would have laid up a large supply of reserve material which would enable them to withstand starvation in the adult stage better than those which pupated early. Perhaps the outcome is a resultant between this factor and the one suggested in the preceding paragraph as explaining the negative correlation found there. The two physiological conditions might largely neutralize each other and the result would be no correlation. At any rate, the fact is that no significant correlation was found between the ability of adults to withstand starvation and the length of the embryonic periods. In three of the four cases the coefficient is less than the probable errors and in the fourth it is less than twice the probable error. The means (Table 2) show the same thing. The only case in which there is a possible relation shown is between the egg-larval period of the females and their ability to withstand starvation. Such as it is, it is in the same direction as that found when considering normal adult life.

It is clear that selective death rate is demonstrated with respect to these physiological characters when the adult flies are given all the food they can eat. When the adult flies are given no food no selection is *demonstrated* but it may nevertheless exist, being masked by complicating circumstances. The explanation, given above, of this masking is not entirely satisfactory. There are still other complications as is shown by a study of the correlations between the durations of the embryonic periods. In the American Museum experiments where the temperature was that of the laboratory, *i. e.* that at which the flies normally live, there was found to be a strong positive correlation between the duration of the egg-larval period and that of the pupal period. In the Carnegie Institution experiments, however, which were conducted at a higher temperature than normal there is no significant correlation between the duration of the embryonic periods. I have no idea what this difference, which is referred to again below, means. I am quite aware that in most of the correlations considered here the regression is not linear but I do not believe that the correlation ratio would alter the significance of the results.

In the starvation experiments we have a pair of anatomical characters to consider. They were selected from among the many which might have been measured simply because they were easy to measure. They give a fair notion of the relative size of the individuals and while not likely to have been directly concerned in selection they are no less likely to have been correlated with the direct factors than any of the other characters which suggested themselves. Table 1 shows that there is a positive correlation between these characters, the length of the first posterior cell in the wing and breadth of the wing, and the ability to withstand starvation. In two cases, the breadth of the wing in males and the length of the posterior cell in females, the correlation is certainly statistically significant. In the other two cases it is barely significant. The difference of the means in those which died early and those which lived longer (see Table 2) was great enough to make it safe to assert that the larger flies, or at least those with larger wings, were better able to withstand starvation than those which were smaller.

		Normal		Starvation	
		Males	Females	Males	Females
Egg-larval Period	General Population	32.3361±1.0725	30.0453±0.9600	9.8273±0.4394	8.4351±0.3638
	Short lived	31.4147±1.4783	29.6227±1.2813	6.5700±0.4205	9.3235±0.6161
	Long lived	30.7086±1.4109	29.1638±1.5437	12.0179±0.7506	7.3585±0.4188
Pupal Period	General Population	14.5452±0.4479	13.8051±0.4137	7.6435±0.3404	9.4768±0.4095
	Short lived	13.4871±0.5905	12.5720±0.4699	7.0453±0.4512	7.1666±0.4719
	Long lived	14.9557±0.6469	14.5707±0.7280	8.1593±0.5057	10.8950±0.6240
Length of Post. Cell	General Population			4.8147±0.2175	4.1844±0.1817
	Short lived			5.3013±0.3450	4.2622±0.2852
	Long lived			4.1794±0.2622	3.9303±0.2244
Breadth of Wing	General Population			5.4514±0.2464	4.5596±0.1981
	Short lived			5.8148±0.3787	4.6039±0.3081
	Long lived			4.5159±0.2834	4.4008±0.2514

Table 3. Coefficients of Variation. See Table 2.

Since in at least half of the cases the mean had been altered by natural selection the coefficient of variation is a better measure of variability than is the standard deviation. Table 3 shows that in the American Museum "normal" set of experiments there was no very marked difference in variability of embryonic periods associated with differences in length of adult life. In the other experiments the males which withstood starvation best were distinctly more variable with respect to the duration of their egg-larval period and only slightly, if at all, more variable with respect to their pupal period than those which succumbed early. As to the females, those which lived longest had been less variable in their egg-larval period and more variable in their pupal period than their weaker sisters. The discordant results, with respect to variability, taking this set of experiments as a whole, gives an additional indication of some unknown complexity influencing the outcome. The males best able to withstand starvation were less variable with respect to the length of the first posterior cell and the breadth of the wing than either those which succumbed early or the general population, while those which succumbed early were slightly but not significantly more variable than the general population. In the case of the females the differences were all insignificant.

		Normal	Starvation	
		Egg-larval and Pupal Periods	Egg-larval and Pupal Periods	Length Post. Cell and Breadth Wing
Males	General Population	+0.7470±0.0189	−0.0561±0.0624	+0.8807±0.0143
	Short lived	+0.6591±0.0344	−0.4383±0.0728	+0.9424±0.0103
	Long lived	+0.8223±0.0194	+0.2238±0.0827	+0.8209±0.0315
Females	General Population	+0.7126±0.0205	−0.0267±0.0601	+0.8449±0.0175
	Short lived	+0.6604±0.0293	−0.2757±0.0856	+0.8254±0.0301
	Long lived	+0.7823±0.0268	+0.1182±0.0789	+0.8014±0.0288

Table 4. Coefficients of Correlation. See Table 2.

In the "normal" experiments both the males and the females which lived longest (see Table 4) showed a distinctly higher correlation between the embryonic periods than did the short-lived ones. In the starvation experiments the survivors had a probably significant positive correlation between the embryonic periods while those which perished had a certainly significant *negative* correlation. Apparently the zero correlation shown by the general population was caused by a mixture of two sorts which natural selection partly, at least separated. In the case of the anatomical characters no difference is shown by the females but the males which succumbed were less highly correlated than those which perished.

These results must seem unsatisfactory to those who look for hard and

ERRATUM

"Experiments with *Drosophila ampelophila* concerning Natural Selection," by Frank E. Lutz. Bulletin American Museum of Natural History, Vol. XXXIV, Art. XXI, p. 610, third line from the bottom. For "succumbed" read "survived."

fast conclusions along certain definite lines. They do, however, demonstrate once more that natural selection does exist and that it influences mean, variability and correlation. Much as we would like to have explanations, the facts are, at present, the important things.

Tables of Data.

Throughout, the units for the egg-larval and pupal periods are days. The units for length of adult life are days in the "normal" experiments and hours in the starvation experiments. The units for the wing measurements are divisions on an arbitrary micrometer scale.

Egg-Larval Period

Survival	4	5	6	7	8	9	10	11	12	13	14	15	16	
5	....	1	....	....	....	....	1	1	....	1	1	....	1	6
10	....	1	2	1	4	2	2	....	....	....	1	....	....	13
15	....	3	5	1	1	5	3	1	1	1	....	1	....	22
20	....	1	6	3	1	11	1	2	1	1	....	....	....	27
25	....	15	3	....	2	2	....	....	....	....	1	....	....	23
30	....	3	6	4	7	9	....	1	1	1	....	....	....	32
35	1	15	16	9	5	1	....	1	1	....	....	....	....	49
40	....	14	5	3	1	....	1	....	....	....	....	....	....	24
45	....	....	....	1	1	....	....	....	....	....	....	....	....	2
50	....	2	....	3	....	....	....	....	....	1	....	....	....	6
55	....	7	1	....	1	1	1	....	....	1	....	....	1	13
60	....	1	1	1	....	....	....	....	....	....	....	....	....	3
65	....	....	....	....	1	....	....	....	1	....	....	....	....	2
70	....	4	....	3	....	1	....	....	....	....	....	....	....	8
75	....	....	....	2	5	....	....	....	1	....	....	....	....	8
80	....	1	....	1	1	....	....	2	1	....	....	....	....	6
85	....	....	....	2	2	1	....	....	....	....	....	....	....	5
90	....	1	....	....	....	....	....	....	....	....	....	....	....	1
	1	69	45	34	32	33	9	8	7	6	3	1	2	250

Table 5. Data for males concerning correlation between the Duration of the Egg-Larval Period and Normal Length of Adult Life.

Egg-Larval Period

Survival	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
5	....	4	1	....	4	1	1	....	2	....	....	....	....	....	13
10	....	2	5	2	3	16	....	1	....	....	....	....	....	....	29
15	....	1	....	1	1	5	2	2	....	....	1	....	....	....	13
20	1	12	20	7	5	2	....	1	....	2	1	....	....	....	51
25	....	6	4	6	7	3	2	....	4	....	....	1	....	1	34
30	....	4	1	8	7	6	1	....	....	....	1	....	....	....	28
35	....	8	13	....	2	1	1	2	1	....	....	....	1	....	29
40	....	5	3	4	3	1	....	....	....	....	....	....	....	....	16
45	....	7	....	1	1	1	....	....	....	1	....	....	....	....	11
50	....	2	....	6	3	....	1	....	....	....	....	....	....	....	12
55	....	5	2	2	3	2	....	....	....	....	....	....	....	....	14
60	....	3	....	....	1	....	....	....	....	....	....	....	....	....	4
65	....	2	....	1	1	....	....	....	....	....	....	....	....	....	4
70	....	....	....	....	2	....	1	....	....	....	....	....	....	....	3
75	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1
80	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1
	1	61	49	38	45	38	9	6	7	3	3	1	1	1	263

Table 6. Data for females concerning correlation between the Duration of the Egg-Larval Period and Normal Length of Adult Life.

Pupal Period

Survival	4	5	6	7	8	
5	....	1	2	3	....	6
10	1	2	3	7	....	13
15	....	5	11	6	....	22
20	1	6	15	5	....	27
25	1	18	2	2	....	23
30	1	12	12	7	....	32
35	....	31	15	3	....	49
40	....	16	7	1		24
45	....	1	1	....	....	2
50	2	2	1	1	....	6
55	7	......	2	3	1	13
60	1	......	2	....	....	3
65	....	......	1	1	....	2
70	4	......	3	1	....	8
75	....	......	7	1	....	8
80	1	......	3	2	....	6
85	....	......	5	....	....	5
90	1	......	......	....	....	1
	20	94	92	43	1	250

Table 7. Data for males concerning correlation between the Duration of the Pupal Period and Normal Length of Adult Life.

Pupal Period

Survival	4	5	6	7	8	
5	3	4	4	1	1	13
10	3	8	17	1	....	29
15	2	......	8	3	....	13
20	2	33	14	2	....	51
25	....	15	16	3	....	34
30	3	12	13	....	....	28
35	6	17	3	3	....	29
40	2	10	4	....	....	16
45	3	6	2	....	....	11
50	1	8	3	....	....	12
55	7	2	3	2	....	14
60	2	2	......	....	....	4
65	1	1	2	....	....	4
70	....	2	1	....	....	3
75	....	1	......	....	....	1
80	....	1	......	....	....	1
	35	122	90	15	1	263

Table 8. Data for females concerning correlation between the Duration of the Pupal Period and Normal Length of Adult Life.

Egg-Larval Period

Survival	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	
48	1	2	2	5	....	....	....	....	10
60	4	12	24	5	1	....	....	....	46
72	5	19	13	8	2	2	....	1	50
84	3	1	1	2	....	....	1	1	9
96	....	1	....	....	....	....	....	....	1
	13	35	40	20	3	2	1	2	116

Table 9. Data for males concerning correlation between the Duration of the Egg-larval Period and Ability to Withstand Starvation.

Egg-Larval Period

Survival	5.6	6.1	6.6	7.1	7.6	8.1	8.6	
36	....	....	1	....	....	....	....	1
48	1	....	....	1	1	....	....	3
60	6	14	17	7	3	2	....	49
72	7	22	16	6	....	....	....	51
84	2	5	10	....	....	....	....	17
96	....	2	....	....	....	....	1	3
	16	43	44	14	4	2	1	124

Table 10. Data for females concerning correlation between the Duration of the Egg-larval Period and Ability to Withstand Starvation.

Pupal Period

Survival	5.5	6.0	6.5	7.0	7.5	8.0	8.5	
48	....	4	5	....	....	....	1	10
60	4	29	10	3	....	....	....	46
72	7	28	7	6	1	1	....	50
84	2	1	4	2	....	....	....	9
96	....	1	....	....	....	....	....	1
	13	63	26	11	1	1	1	116

Table 11. Data for males concerning correlation between the Duration of the Pupal Period and Ability to Withstand Starvation.

Pupal Period

Survival	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	
36	....	....	1	....	....	....	....	....	....	1
48	....	1	1	....	....	1	....	....	....	3
60	....	26	18	3	2	....	....	....	....	49
72	2	31	14	1	1	....	....	1	1	51
84	1	12	2	1	1	....	....	....	....	17
96	....	....	1	1	1	....	....	....	....	3
	3	70	37	6	5	1	....	1	1	124

Table 12. Data for females concerning correlation between the Duration of the Pupal Period and Ability to Withstand Starvation.

Length of Posterior Cell

Survival	41.5	42.5	43.5	44.5	45.5	46.5	47.5	48.5	49.5	50.5	
48	.....	2	1	.....	.....	2	.....	4	.....	.....	9
60	2	11	3	3	3	5	12	5	1	.....	45
72	1	3	3	6	5	9	14	3	2	2	48
84	.....	.....	.....	2	2	2	1	2	.....	.....	9
96	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
	3	16	7	11	10	19	27	14	3	2	112

Table 13. Data for males concerning correlation between the Length of the Posterior Cell and Ability to Withstand Starvation.

Length of Posterior Cell

Survival	47.5	48.5	49.5	50.5	51.5	52.5	53.5	54.5	56.5	57.5	
36	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
48	.....	1	.....	.....	.....	1	1	.....	.....	.....	3
60	4	3	6	1	5	13	7	6	2	.....	47
72	3	3	2	1	4	10	13	11	2	1	50
84	.....	.....	1	1	1	3	2	6	3	.....	17
96	.....	.....	.....	1	.....	.....	1	1	.....	.....	3
	7	7	9	4	10	28	24	24	7	1	121

Table 14. Data for females concerning correlation between the Length of the Posterior Cell and Ability to Withstand Starvation.

Breadth of Wing

Survival	27.5	28.5	29.5	30.5	31.5	32.5	33.5	34.5	
48	.....	2	2	1	.....	2	2	.....	9
60	2	8	5	5	7	14	4	.....	45
72	1	2	2	5	11	13	12	2	48
84	.....	.....	.....	2	1	3	3	.....	9
96	.....	.....	.....	.....	.....	1	.....	.....	1
	3	12	9	13	19	33	21	2	112

Table 15. Data for males concerning correlation between the Breadth of the Wing and Ability to Withstand Starvation.

Breadth of Wing

Survival	30.5	31.5	32.5	33.5	34.5	35.5	36.5	37.5	
36	.....	.....	.....	.....	.....	1	.....	.....	1
48	.....	1	.....	.....	.....	2	.....	.....	3
60	1	2	2	6	8	14	10	4	47
72	.....	4	3	2	5	11	15	10	50
84	.....	.....	.....	.....	3	7	4	3	17
96	.....	.....	.....	.....	.....	3	.....	.....	3
	1	7	5	8	16	38	29	17	121

Table 16. Data for females concerning correlation between the Breadth of the Wing and Ability to Withstand Starvation.

Pupal Period

Egg-Larval Period	4	5	6	7	8	
4	....	....	1	....	....	1
5	17	51	1	....	....	69
6	1	26	18	....	....	45
7	....	13	19	2	....	34
8	....	4	20	7	1	32
9	1	....	26	6	....	33
10	....	....	2	7	....	9
11	....	....	1	7	....	8
12	....	....	2	5	....	7
13	....	....	1	5	....	6
14	1	....	....	2	....	3
15	....	....	1	....	....	1
16	....	....	....	2	....	2
	20	94	92	43	1	250

Table 17. Data for the general population of males concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Normal experiments.

Egg-Larval Period \ Pupal Period	4	5	6	7	8	
4	....	1	....	....	....	1
5	29	31	1	....	....	61
6	4	37	8	....	....	49
7	....	24	14	....	....	38
8	1	25	17	2	....	45
9	....	2	33	3	....	38
10	....	....	7	2	....	9
11	1	....	2	3	....	6
12	....	1	3	2	1	7
13	....	....	3	....	....	3
14	....	....	1	2	....	3
15	....	....	....	1	....	1
16	....	....	1	....	....	1
17	....	1	....	....	....	1
	35	122	90	15	1	263

Table 18. Data for the general population of females concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Normal Experiments.

Egg-Larval Period \ Pupal Period	4	5	6	7	
5	1	23	....	....	24
6	1	12	9	....	22
7	....	5	2	2	9
8	....	4	4	7	15
9	1	....	24	4	29
10	....	....	2	5	7
11	....	....	1	4	5
12	....	....	1	2	3
13	....	....	1	3	4
14	1	....	....	2	3
15	....	....	1	....	1
16	....	....	....	1	1
	4	44	45	30	123

Table 19. Data for those males which lived less than 32.5 days concerning correlation between the Durations of the Egg-larval and Pupal Periods. Normal Experiments.

	Pupal Period					
Egg-Larval Period	4	5	6	7	8	
4	....	1	....	....	....	1
5	9	19	1	....	....	29
6	2	22	7	....	....	31
7	....	14	10	....	....	24
8	1	14	10	2	....	27
9	....	....	32	1	....	33
10	....	....	4	2	....	6
11	1	....	2	1	....	4
12	....	1	3	1	1	6
13	....	....	2	....	....	2
14	....	....	1	2	....	3
15	....	....	....	1	....	1
16	....	....	....	....	....	......
17	....	1	....	....	....	1
	13	72	72	10	1	168

Table 20. Data for those females which lived less than 32.5 days concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Normal Experiments.

	Pupal Period					
Egg-Larval Period	4	5	6	7	8	
4	....	....	1	....	....	1
5	16	28	1	....	....	45
6	....	14	9	....	....	23
7	....	8	17	....	....	25
8	....	....	16	....	1	17
9	....	....	2	2	....	4
10	....	....	....	2	....	2
11	....	....	....	3	....	3
12	....	....	1	3	....	4
13	....	....	....	2	....	2
14	....	....	....	....	....	......
15	....	....	....	....	....	......
16	....	....	....	1	....	1
	16	50	47	13	1	127

Table 21. Data for those males which lived more than 32.5 days concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Normal Experiments.

Pupal Period

Egg-Larval Period	4	5	6	7	
5	20	12	....	....	32
6	2	15	1	....	18
7	....	10	4	....	14
8	....	11	7	....	18
9	....	2	1	2	5
10	....	....	3	....	3
11	....	....	....	2	2
12	....	....	....	1	1
13	....	....	1	....	1
14	....	....	....	....	......
15	....	....	....	....	......
16	....	....	1	....	1
	22	50	18	5	95

Table 22. Data for those females which lived more than 32.5 days concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Normal Experiments.

Pupal Period

Egg-Larval Period	5.5	6.0	6.5	7.0	7.5	8.0	8.5	
5.6	....	1	10	....	1	....	1	13
6.1	....	26	4	5	....	....	....	35
6.6	9	24	6	1	....	....	....	40
7.1	4	9	4	2	....	1	....	20
7.6	....	2	1	....	....	....	....	3
8.1	....	....	....	2	....	....	....	2
8.6	....	....	1	....	....	....	....	1
9.1	....	1	....	1	....	....	....	2
	13	63	26	11	1	1	1	116

Table 23. Data for the general population of males concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Starvation Experiments.

Pupal Period

Egg-Larval Period	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	
5.6	....	6	8	1	....	1	....	....	....	16
6.1	3	19	17	....	3	....	....	....	1	43
6.6	....	32	10	1	1	....	....	....	....	44
7.1	....	8	2	2	1	....	....	1	....	14
7.6	....	3	....	1	....	....	....	....	....	4
8.1	....	2	....	....	....	....	....	....	....	2
8.6	....	....	....	1	....	....	....	....	....	1
	3	70	37	6	5	1	....	1	1	124

Table 24. Data for the general population of females concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Starvation Experiments.

Pupal Period

Egg-Larval Period	5.5	6.0	6.5	7.0	7.5	8.0	8.5	
5.6	....	1	3	....	....	....	1	5
6.1	....	8	4	2	....	....	....	14
6.6	1	20	4	1	....	....	....	26
7.1	3	3	4	....	....	....	....	10
7.6	....	1	....	....	....	....	....	1
	4	33	15	3	....	....	1	56

Table 25. Data for those males which lived less than 66 hours concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Starvation Experiments.

Pupal Period

Egg-Larval Period	5.5	6.0	6.5	7.0	7.5	
5.6	1	5	....	....	1	7
6.1	6	7	....	1	....	14
6.6	10	7	....	1	....	18
7.1	5	1	2	....	....	8
7.6	3	....	1	....	....	4
8.1	2	....	....	....	....	2
	27	20	3	2	1	53

Table 26. Data for those females which lived less than 66 hours concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Starvation Experiments.

Egg-Larval Period	Pupal Period 5.5	6.0	6.5	7.0	7.5	8.0	
5.6	....	....	7	....	1	....	8
6.1	....	18	....	3	....	....	21
6.6	8	4	2	....	....	....	14
7.1	1	6	....	2	....	1	10
7.6	....	1	1	....	....	....	2
8.1	....	....	....	2	....	....	2
8.6	....	....	1	....	....	....	1
9.1	....	1	....	1	....	....	2
	9	30	11	8	1	1	60

Table 27. Data for those males which lived more than 66 hours concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Starvation Experiments.

Egg-Larval Period	Pupal Period 5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	
5.6	....	5	3	1	....	....	....	....	....	9
6.1	3	13	10	....	2	....	....	....	1	29
6.6	....	22	3	1	....	....	....	....	....	26
7.1	....	3	1	....	1	....	....	1	....	6
7.6	....	....	....	....	....	....	....	....	....	....
8.1	....	....	....	....	....	....	....	....	....	....
8.6	....	....	....	1	....	....	....	....	....	1
	3	43	17	3	3	....	....	1	1	71

Table 28. Data for those females which lived more than 66 hours concerning correlation between the Durations of the Egg-Larval and Pupal Periods. Starvation Experiments.

Breadth of Wing

Length of Posterior Cell	27.5	28.5	29.5	30.5	31.5	32.5	33.5	34.5	
41.5	1	2	.....	.....	.....	.....	.....	.....	3
42.5	2	9	4	1	.....	.....	.....	.....	16
43.5	.....	1	4	2	.....	.....	.....	.....	7
44.5	.....	.....	.....	5	3	3	.....	.....	11
45.5	.....	.....	.....	4	3	1	2	.....	10
46.5	.....	.....	1	1	6	9	2	.....	19
47.5	.....	.....	.....	.....	5	13	9	.....	27
48.5	.....	.....	.....	.....	2	7	5	.....	14
49.5	.....	.....	.....	.....	.....	.....	2	1	3
50.0	.....	.....	.....	.....	.....	.....	1	1	2
	3	12	9	13	19	33	21	2	112

Table 29. Data for the general population of males concerning correlation between the Length of the First Posterior Cell and the Breadth of the Wing. Starvation Experiments.

Breadth of Wing

Length of Posterior Cell	30.5	31.5	32.5	33.5	34.5	35.5	36.5	37.5	
47.5	1	3	1	2	.....	.....	.....	.....	7
48.5	.....	3	2	1	1	.....	.....	.....	7
49.5	.....	1	2	4	2	.....	.....	.....	9
50.5	.....	.....	.....	.....	3	1	.....	.....	4
51.5	.....	.....	.....	.....	3	5	2	.....	10
52.5	.....	.....	.....	1	4	14	5	4	28
53.5	.....	.....	.....	.....	3	9	9	3	24
54.5	.....	.....	.....	.....	.....	8	11	5	24
55.5	.....	.....	.....	.....	.....	1	2	4	7
56.5	.....	.....	.....	.....	.....	.....	.....	1	1
	1	7	5	8	16	38	29	17	121

Table 30. Data for the general population of females concerning correlation between the Length of the First Posterior Cell and the Breadth of the Wing. Starvation Experiments.

Breadth of Wing

Length of Posterior Cell	27.5	28.5	29.5	30.5	31.5	32.5	33.5	
41.5	1	1	.....	.....	.....	.....	.....	2
42.5	1	9	2	1	.....	.....	.....	13
43.5	.....	.....	4	.....	.....	.....	.....	4
44.5	.....	.....	.....	2	1	.....	.....	3
45.5	.....	.....	.....	2	1	.....	.....	3
46.5	.....	.....	1	1	2	3	.....	7
47.5	.....	.....	.....	.....	2	8	2	12
48.5	.....	.....	.....	.....	1	5	3	9
49.5	.....	.....	.....	.....	.....	.....	1	1
	2	10	7	6	7	16	6	54

Table 31. Data for those males which lived less than 66 hours concerning correlation between the Length of the First Posterior Cell and the Breadth of the Wing. Starvation Experiments.

Breadth of Wing

Length of Posterior Cell	30.5	31.5	32.5	33.5	34.5	35.5	36.5	37.5	
47.5	1	1	1	1	.....	.....	.....	.....	4
48.5	.....	2	.....	1	1	.....	.....	.....	4
49.5	.....	.....	1	4	1	.....	.....	.....	6
50.5	.....	.....	.....	.....	1	.....	.....	.....	1
51.5	.....	.....	.....	.....	2	2	1	.....	5
52.5	.....	.....	.....	.....	2	9	3	1	15
53.5	.....	.....	.....	.....	1	4	3	.....	8
54.5	.....	.....	.....	.....	.....	2	3	1	6
55.5	.....	.....	.....	.....	.....	.....	.....	2	2
	1	3	2	6	8	17	10	4	51

Table 32. Data for those females which lived less than 66 hours concerning correlation between the Length of the First Posterior Cell and the Breadth of the Wing. Starvation Experiments.

Breadth of Wing

Length of Posterior Cell	27.5	28.5	29.5	30.5	31.5	32.5	33.5	34.5	
41.5		1							1
42.5	1		2						3
43.5		1		2					3
44.5				3	2	3			8
45.5				2	2	1	2		7
46.5					4	6	2		12
47.5					3	5	7		15
48.5					1	2	2		5
49.5							1	1	2
50.5							1	1	2
	1	2	2	7	12	17	15	2	58

Table 33. Data for those males which lived more than 66 hours concerning correlation between the Length of the First Posterior Cell and the Breadth of the Wing. Starvation Experiments.

Breadth of Wing

Length of Posterior Cell	31.5	32.5	33.5	34.5	35.5	36.5	37.5	
47.5	2		1					3
48.5	1	2						3
49.5	1	1		1				3
50.5				2	1			3
51.5				1	3	1		5
52.5			1	2	5	2	3	13
53.5				2	5	6	3	16
54.5					6	8	4	18
55.5					1	2	2	5
56.5							1	1
	4	3	2	8	21	19	13	70

Table 34. Data for those females which lived for more than 66 hours concerning correlation between the Length of the First Posterior Cell and the Breadth of the Wing. Starvation Experiments.

59.9(8)

Article XXII.— NEW SOUTH AMERICAN MAMMALS.

By J. A. Allen.

Dasyprocta fuliginosa candelensis subsp. nov.

Type, No. 33902, ♀ ad., La Candela (altitude 6500 feet), Huila, Colombia, May 11, 1912; Leo E. Miller.

Midline of back, from the shoulders posteriorly, deep black; rest of the upperparts with the hairs black for the greater part of their length, annulated near the tip with white or pale yellow, giving a grizzled gray general effect, the variegation varying in different specimens from slight (black prevailing) to profuse (gray prevailing); ventral surface grizzled with dusky and white, the base of the hairs dusky and the tips broadly ringed with white, with a broad mid-ventral line of clear white; feet wholly black or black with the tips of the hairs minutely punctated with white or yellowish white.

Field measurements (type), total length, 570 mm.; tail, 30; hind foot (c. u.), 130. Type and 3 paratypes, total length, 550 (530–570); tail, 25 (20–30); hind foot, 130 (all 130). Skull (type), total length, 122.7; condylobasal length, 116; zygomatic breadth, 52.5; interorbital breadth, 31; diastema, 32; maxillary toothrow, 21.5. The type skull is that of an old female, in which the basioccipito-basisphenoid suture is obliterated by ankylosis. A paratype skull of an old female, perfectly comparable in age with the type, is much shorter and less massive, the total length being 111, the condylobasal length 103.5, zygomatic breadth 53, interorbital 30, diastema 29, maxillary toothrow 29.3. An adult male skull (the basioccipito-basisphenoid suture still open) agrees closely with the last mentioned old female in all cranial measurements.

Represented by 4 adult specimens, all from near the type locality (altitudes of 3000 to 6500 feet), as follows: La Candela, 1; San Agustin, 1; Andalucia, 1; and 1 without definite locality (through loss of the collector's label), but doubtless from one of these three localities.

A furrier's skin from the Bogotá district is referable also to this subspecies, indicating that it ranges northward along the eastern slope of the Eastern Andes to the vicinity of Bogotá, a range common to various other rodents of this region.

D. fuliginosa candelensis is darker even than typical *fuliginosa*, to which it is more nearly related, both morphologically and geographically, than to any other known form of the genus.

The type locality of *Dasyprocta fuliginosa* Wagler[1] is not definitely

[1] *Dasyprocta fuliginosa* Wagler, Isis, 1832, p. 1220. "Habitat in Brasilia versus flumen Amazonum." Based on a young specimen obtained by Spix (*apud* Wagner, *l. c.*, 1844, p. 48).

Dasyprocta nigricans Wagner, Arch. f. Naturg., 1842, I, p. 362. "Von Borba am Madairo und vom Rio Negro oberhalb des Cocuy."— Wagner, Schreber's Säug., Suppl., IV, 1844, p. 48.

Dasyprocta nigra Gray, Ann. and Mag. Nat. Hist., X, p. 264, Dec. 1842. "South America." — Gray, Voyage Sulphur, I, 1844, Mamm., p. 36, pl. xvi. "Tropical America."

indicated, but the type specimen, an immature animal, was obtained by the Spix Expedition (according to Wagner, *l. c.*, 1844, p. 48), which spent much time exploring that part of the Amazonian region, which includes the lower Rio Madeira and lower Rio Negro. Wagner (*l. c.*) states that Spix's type came from the same region (Gegenden) as Natterer's specimens. *Dasyprocta nigricans* Wagner was based on specimens collected by Natterer in part at Villa de Borba, on the lower Rio Madeira, with which Wagner (*l. c.*, 1844, p. 48) compared Wagler's type and considered it identical with Natterer's specimens, but he did not adopt Wagler's earlier name. The type locality of *fuliginosa* may therefore properly be designated as Villa de Borba, on the basis of the known type locality of *nigricans*. Five specimens collected by Leo E. Miller (Roosevelt Brazilian Expedition) at Calama, a short distance above Borba, on the lower Rio Madeira, are here regarded as typically representative of *nigricans* and hence also of *fuliginosa*.

The collector's measurements of an old adult male and an old adult female are as follows: Total length, ♂ 630, ♀ 590; tail, 30, 20; hind foot c. u., ♂ 135, ♀ 130. Skulls of the same specimens: Total length, ♂ 109.5, ♀ 114; condylobasal length, ♂ 101.5, ♀ 104; zygomatic breadth, ♂ 53.5, ♀ 47.5; interorbital breadth, ♂ 33, ♀ 32; diastema, ♂ 29.4, ♀ 28; maxillary toothrow, ♂ 29.4, ♀ 29.7.

This series shows some individual variation in coloration, but the average condition may be indicated as follows: Upperparts black, the tips of the hairs narrowly annulated with pale yellowish or white, with a broad band of black along the middle of the dorsal region; hairs of the lower back and rump greatly lengthened, intense black, with long white tips, forming a conspicuous veiling of the surface; ventral surface grizzled whitish and dusky, the midline whitish, the annulations of the hair-tips often tinged with pale yellowish.

The *Dasyprocta fuliginosa* group is evidently closely related to the *D. variegata* group, and it will probably be found that the two constitute a single large assemblage of local forms, ranging over the greater part of South America. *Dasyprocta aurea* Cope[1] from Chapada, Matto Grosso, is the southeastern representative of the group, *D. colombiana* of the Santa Marta district and *D. isthmica* of Panama are the northern forms, *D. variegata* and *D. yungarum* of Peru and Bolivia the southwestern forms, with the two described below, from Ecuador and western Colombia, completing the western periphery of the area of distribution. *D. colombiana* seems to represent the maximum in size and to form the connecting link between the dark *fuliginosa* forms of the central Amazonian Basin and the lighter or more

[1] For further reference to this species see below, p. 633.

ochraceous forms of the western border of the range of the group. With a series of more than 20 specimens before me from Santa Marta, it is difficult to decide whether *D. colombiana* is more closely affiliated with typical *variegata* than with typical *fuliginosa*. In all probability *D. aurea* and *D. yungarum* will also prove to be closely related *inter se* through an intermediate form in southern Bolivia.

Dasyprocta variegata zamoræ subsp. nov.

Type, No. 36582, ♀ ad., Zamora (altitude 2000 feet), Ecuador, Nov. 1, 1913; Wm. B. Richardson.

Similar to *Dasyprocta variegata* Tschudi, but the annulations of the tips of the hairs much broader, more abundant, and of a more reddish tone — deep ochraceous tawney instead of yellow, and the rump hairs with rather long white tips in unworn specimens, instead of practically wanting as in *variegata*.

Represented by 4 adult females, all collected by Wm. B. Richardson, as follows: Zamora, 1; Naranjo, 2; another labeled "Quito" by the collector, but doubtless erroneously, although unquestionably from Ecuador.

Collector's measurements of the type and the two Naranjo specimens: Total length, type 620, Naranjo specimens 580, 650; tail —, 30, 30; hind foot, 120, 120, 120. Four skulls, total length, 109 (105–115); condylobasal length, 101 (96.5–103); zygomatic breadth, 48.6 (47–49.5); interorbital breadth, 29.8 (28.5–31.5); diastema, 26 (25–28); maxillary toothrow, 19.5 (19–20.5).

D. v. zamoræ differs from typical *D. variegata* as indicated above, and from *D. v. yungarum* especially in the color of the mid-ventral surface, which is "orange-ochraceous" in *yungarum* and white in *zamoræ*.

Although Zamora and Naranjo are situated respectively on the eastern and western slopes of the Andes, the specimens from these two localities do not differ appreciably in coloration or other features.

Dasyprocta variegata chocoensis subsp. nov.

Dasyprocta variegata variegata Allen, Bull. Amer. Mus. Nat. Hist., XXXI, p. 70, April 19, 1912.

Type, No. 32153, ♂ juv., Los Cisneros (altitude 600 feet), Chocó district, Colombia, March 9, 1911; Wm. B. Richardson.

Similar in general coloration to *Dasyprocta variegata zamoræ*, but with much longer white tips to the hairs of the rump, and the ochraceous annulations of the hairs of the back and flanks broader and more yellow, varying in different individuals from ochraceous buff to ochraceous orange.

Total length, type (♂ juv.) 550 mm., topotype (♂ ad.) 580; hind foot, 120, 130. Skulls of same specimens, total length, (type) —, (topotype) 111.5; condylobasal length, 100, 102; zygomatic breadth, 44.6, 49; interorbital breadth, 28.5, 29.3; diastema, 29, 29.6; maxillary toothrow, 22, 19.

Five specimens are referred to this form, representing the following localities, all in the tropical coast zone of western Colombia: Los Cisneros, 2; Rio Osculo, Baudo, and Bagado, each 1. The Bagado specimen is not typical, it differing from the others in having the top of the head and back of the neck to the shoulders very much darker than the others, but is otherwise similar.

This form is related on the one hand to subspecies *zamoræ,* as noted above, and on the other to subspecies *colombiana.* Indeed, in the large series of the latter from near Bonda (Santa Marta district), are specimens closely similar to some of the Chocó specimens, but the two series as a whole present well-marked color differences, *colombiana* being grayer, the annulations of the hair tips paler and narrower, the white tips of the hairs of the rump shorter, with a tendency to a conspicuous blackish area on the back anterior to the rump, which latter feature is absent in *chocoensis* and *zamoræ.* The skulls, however, show that *colombiana* is a much larger animal than either *zamoræ* or *chocoensis,* with a broader and much more massive skull.

Two half-grown specimens from Frijolera, Antioquia, closely resemble specimens of similar age from Santa Marta, and are here provisionally referred to *colombiana.*

D. v. chocoensis is not closely related to *D. isthmica,* the latter being paler with the long light tips to the hairs of the rump distinctly yellowish instead of white. So far as coloration is concerned, *D. isthmica* presents a striking similarity to *D. aurea* of the far away region of southern Matto Grosso.

Note on the Orange-rumped Agoutis.

The earliest available names for the orange-rumped agoutis appear to be *Dasyprocta croconota* Wagler for the Amazonian form and *D. prymnolopha* Wagler [1] for the Guiana form. No definite type locality was given for either, but *D. croconota* was based on a specimen collected by Spix on the Amazon, and *D. prymnolopha* on specimens from Guiana. Two specimens in the American Museum collected by Leo E. Miller (Roosevelt Brazilian Expedition) at Calama, on the lower Rio Madeira, agree satisfactorily with Wagler's description of his *D. croconota.*[2] As Spix spent a long time on the Amazon near its junction with the Rio Madeira and Rio Negro, and ascended the lower parts of both of these rivers, it seems not unreasonable to indicate

[1] *Dasyprocta croconota* Wagler, Isis, 1831, p. 618. "Brasilia ad flumen Amazonum." From Spix's Expedition.

Dasyprocta prymnolopha Wagler, *ibid.*, p. 619. "Habitat in Guiana."

[2] Except that the incisors are not white. It is probable that the ascribed "dentibus primoribus toto niveis" is an exceptional condition. In over 100 *Dasyprocta* skulls now before me, not one has the incisors all white, but in three or four they are pale yellowish white, or mottled with pale yellow and white, giving a whitish general effect.

the immediate vicinity of the mouth of Rio Madeira as the type locality of *Dasyprocta croconota.*

The *D. croconota* group ranges northward to the Guianas and Venezuela (Orinoco basin), both of which regions are represented by specimens of this group in the American Museum. Some of the Venezuela specimens are practically topotypes of *Dasyprocta lucifer* Thomas, which form I believe should be known as *Dasyprocta croconota lucifer.* The Guiana specimens, a series of 6, are from northern British Guiana, and seem to be distinctly referable to *D. prymnolopha.* They also agree satisfactorily with Thomas's description of his *Dasyprocta lucifer cayennæ,* with which I had identified them before I took up the case of *D. prymnolopha.* It seems to me now, however, that the "Guiana" form should be known as *Dasyprocta croconota prymnolopha,* unless more than one form should be found to exist in the Guianas, when it would be necessary to designate a definite type locality for Wagler's *prymnolopha,* which may or may not have come from Cayenne.

Proechimys kermiti sp. nov.

Type (and only specimen), No. 37124, ♀ ad., Lower Rio Solimoens, April 20, 1914; Leo E. Miller. Roosevelt Brazilian Expedition.

Named for Kermit Roosevelt, in recognition of his important contributions to the natural history results of the Roosevelt Expedition.

Similar in size to *Proechimys centralis,* but with the underparts buffy drab instead of clear white, and important cranial differences.

Upperparts ochraceous buff lined with black, paler on the head, shoulders, and outer surface of limbs, brighter on the sides, darker on the middorsal region where black prevails from a little behind the shoulders to the rump, forming a broad blackish band; lower parts pale buff on throat and middle of the ventral surface, passing into drab laterally, and thence merging into the color of the upperparts, without a sharp dividing line between the sides and the ventral surface; outside of limbs like sides of body; inside of fore limbs like the breast, inside of hind limbs with a broad longitudinal band of strong buff; feet dull brown, rather thinly haired.

Head and body, 310 mm.; tail absent, having been shed in life; hind foot, 55.

Skull, total length, 65.5; zygomatic breadth, 29.5; interorbital breadth, 13.5; parietal breadth, 22.3; length of nasals, 28 × 6; diastema, 13; maxillary toothrow, 9.

Nasals very broad, bluntly pointed posteriorly and extending back to a line transverse to the anterior border of the orbital fossæ; frontals with a heavily thickened border, continued over the front half of the parietals; maxillary toothrows perfectly parallel, not converging anteriorly as in most species of the genus.

This is one of the largest species of the genus, about equalling *P. centralis* in size, but differing from it externally in the upper parts being darker and paler with a much stronger dark median band, and in the underparts being mixed buffy and drab. The upperparts are nearly like the upperparts in average specimens of *P. semispinosus,* which, however, is white below as in *P. centralis,* and a very much smaller species with markedly different cranial characters.

Oryzomys incertus *Allen* (preoccupied).

I am indebted to Mr. E. A. Goldman for kindly calling my attention to the preoccupation of the name *Oryzomys incertus* (this Bulletin, XXXII, p. 598, Dec. 3, 1913) by my previous *Oryzomys alfari incertus* (this Bulletin, XXIV, p. 655, Oct. 13, 1908). My later *O. incertus* is here renamed **Oryzomys mureliæ**, after the type locality.

Procyon (Euprocyon) æquatorialis sp. nov.

Type, No. 36458, ♂ ad., western Ecuador, probably near the coast in Manavi Province, June, 1913; W. B. Richardson. (The collector's label was lost in transit, but the specimen was taken on his route from Manavi to Mt. Pichincha, via Gualea. The hispid character of the pelage indicates that it was taken in the tropical coast belt.)

Pelage very short and bristly. Similar in general coloration to specimens of *Procyon cancrivorus nigripes* from Corrientes, Argentina, but pelage very short, stiff and without underfur, the general tone much yellower, the black tipping of the hairs of the upperparts much shorter, the tail and feet with much less black. Frontal band on face broad and deep black, posteriorly enclosing the eyes; a whitish band above the eyes extending nearly to base of ears; top of head and nape gray strongly varied with black, the hairs being whitish at base with black tips; upperparts yellowish, the hairs tipped with black, forming a blackish wash; underparts maize yellow; forearm and ankles black; feet pale buffy brown; tail below light maize yellow, paler above with indistinct blackish half-rings; ears externally like the nape, edged with yellowish white, internally yellowish white.

Total length (in skin), 1070 mm.; head and body, 755; tail vertebræ, 315; hind foot, 95.

Skull, total length, 127; condylobasal length, 119; palatal length, 69; zygomatic breadth, 87; interorbital breadth, 26; postorbital breadth, 25; breadth of braincase, 54; mastoid breadth, 71; maxillary toothrow, 40.3.

The skull is that of an old male, with a low sagittal and heavy occipital crests. Dentition intermediate between that of *cancrivorus* [1] and *proteus* — less massive than in the former and heavier than in the latter.

In coloration the Ecuador form is quite distinct from any of the previously described forms.

As already noted, the exact type locality is not known, but the short, hispid pelage seems to imply that it must be in the tropical coast region of Manavi.

[1] An adult male skull from Trinidad, Guiana specimens being unavailable for comparison.

Margay tigrina elenæ subsp. nov.

Type, No. 37788, ♂ ad., Santa Elena (altitude 9000 feet), Antioquia, Colombia, Jan. 11, 1915; L. E. Miller and H. A. Boyle.

Similar in general coloration to *Margay tigrina emerita* (*Felis pardinoides emerita* Thomas) of the Venezuelan Andes (Merida district), but the palms and soles are strongly blackish instead of the feet being "scarcely darker below than above," and the skull is relatively shorter and broader. The ground color above is rather deeper tawny, but the markings are similar in all essential details.

Represented by the type only, an old male with the skull sutures wholly obliterated. A specimen from Almaguer (skin without skull) is provisionally referred to it.

There are no field measurements, but the skull measures as follows as compared with a topotype skull of *emerita* (measurements of the latter in parenthesis): Total length, 86 (86); condylobasal length, 79.3 (82.5); zygomatic breadth, 58 (57); breadth of braincase, 39 (37); interorbital breadth, 16 (15); postorbital constriction 28 (26); tip to tip of postorbital processes, 41.5 (41); length of upper toothrow (including canine), 24.5 (24.5); length of p^4, 9.3 (9.6).

While the total length of the skull is the same in the type of *elenæ* as in a topotype of *emerita,* the condylobasal length is 3 mm. less in the type of *elenæ* than in the topotype of *emerita,* due to the more posterior position of the condyles in *emerita.* This gives a strikingly different aspect to the occipital region of the skull, especially when viewed in profile, the occipital plane in *emerita* being nearly vertical, in *elenæ* strongly oblique, owing to the more anterior position of the condyles. The two skulls are perfectly comparable in respect to age and sex.

Margay caucensis sp. nov.

Type, No. 14187 (skin only), Las Pavas (altitude 6000 feet), near San Antonio, upper Rio Cauca, Colombia; J. H. Batty.

The markings of the upperparts are intense black, sharply defined, and greatly exceed in area the deep fulvous ground color; similar in other respects to the color pattern of the margay cats. Underparts with the belly fulvous sharply spotted with black, the ground color lighter along the midline; chest, axillar regions and fore neck white or whitish, with the usual black bars behind the throat and on the lower fore neck; a well-marked yellowish white superciliary line; white ear spots small; tail with the strong black rings complete on the apical third; palms and soles brownish black.

Total length (measurements from skin), 760 mm.; tail vertebræ, 300; hind foot, 95. The skull is unfortunately lacking.

This specimen is strikingly different in coloration from any of the hitherto described margay cats of western South America, through the predominance of the intensely black markings over the ground color, and the deep fulvous tone of the latter.

Oncoides pardalis tumatumari subsp. nov.

Type, No. 36318, ♂ ad., Tumatumari, British Guiana, Sept., 1913; Leo E. Miller.

A form of the *pardalis* group, distinguished especially by large size and dark coloration. Nape hairs reversed.

Upperparts with the dark markings very heavy, black greatly predominating; ground color tawny on back, passing into grayish white or whitish on the flanks and limbs; ventral surface and inside of limbs white heavily marked with black; upper surface of tail black, with five narrow white rings on the basal half, the apical half wholly black above with narrow half-rings of white on the under surface.

Field measurements: total length, 1230 mm.; head and body, 905; tail vertebræ, 325; hind foot, 130. Skull, total length, 151; condylobasal length, 139; zygomatic breadth, 97.5; interorbital breadth, 32; postorbital breadth, 32; breadth of braincase, 54; length of nasals on midline, 31.5, on border 40; maxillary toothrow, 32; upper carnassial, 16.5 × 8.5.

Various names have been given to South American representatives of the *pardalis* group,[1] based on specimens from unknown localities, often living animals in menageries, and unidentifiable. In view of this fact it seems better to give a new name to the British Guiana form than to attempt a reference of it to any of the vaguely described forms from "Brazil" or "South America."

Eptesicus chapmani sp. nov.

Type, No. 37057, ♀ ad., Lower Rio Solimoens, April 30, 1914; Leo E. Miller. Roosevelt Brazilian Expedition.

Similar in coloration to *Eptesicus dorianus* (Dobson) but larger; smaller than *E. hilarii* (I. Geoffroy), and quite differently colored — less suffused with fulvous both above and below.

Upperparts uniform bistre, the extreme tips of the hairs barely perceptibly lighter; underparts similar but lighter, the tips of the hairs distinctly grayish buffy; membranes blackish.

External measurements (type), expanse, 292 mm.; total length, 95; head and body, 55; tail, 40; hind foot, 8; ear from crown, 10. Type and 5 topotypes, ex-

[1] *Cf.* Mearns, Proc. U. S. Nat. Museum, XXI, No. 1286, pp. 237–249 (especially, in this connection, pp. 237–241). The type locality of *Felis chibigouazou* Griffith ("South America") may be considered as Chapada, Matto Grosso, Brazil, on the basis of Mearns's detailed description of the species from Chapada specimens.

panse, 285.6 (275–294); total length, 93.5 (90–98); head and body, 49.3 (45–54); tail, 40.4 (38–43); foot, 8.2 (8–9); ear, 9.7 (9–10). Fore arm, type, 40; average of 6 specimens, 39.7 (39–40).

Skull (type), total length, 15.7 (15)[1]; zygomatic breadth, 11.6 (10); interorbital breadth, 4 (3.4); breadth of braincase, 6.8 (7); maxillary toothrow, including canine, 5.5 (5); palatal breadth from outside to outside of m^3, 6.8 (6.2).

The series of 6 specimens on which the present species is based are remarkably uniform in size and coloration, the length of the forearm varying only from 39 to 40 mm. (4 of them each 40 mm.), and the color variation consists mainly in the underparts being a little more strongly washed with buffy gray in some than in others. Compared with *E. dorianus* the coloration is closely similar but the forearm is 3 mm. shorter in *dorianus*, and the skull is much narrower relatively to the length and much smaller.

With *E. hilarii* it hardly needs comparison, it being much smaller, and lacking the fulvous tone of color seen in *hilarii;* yet the skulls are quite similar. It is not closely related to *Eptesicus diminutus* Osgood, from São Marcello, Bahia.

Named for Dr. Frank M. Chapman, who has so ably planned and directed the Museum's recent zoölogical work in South America.

POSTSCRIPT.

Since the foregoing pages were made up for press I have received for examination, through the kindness of Dr. Witmer Stone, Curator of the Academy of Natural Sciences of Philadelphia, the type of Cope's *Dasyprocta aurea*,[2] an adult skin, without skull, collected by Mr. H. H. Smith at Chapada, Matto Grosso, Brazil, December, 1883 (collector's No. 293). This skin proves to be albinistic, not a white but a yellow albino, the pelage being everywhere deep yellow, mostly orange yellow on the upperparts, paler on the ventral surface; the long hairs on the rump are much paler than the rest of the dorsal surface, and paler basally than at the tips. None of the hairs are annulated, as in normal specimens of the genus. Before receiving the type of *aurea* I had referred to it a specimen collected by Leo E. Miller, during the Roosevelt Brazilian Expedition, at Urucum, about 20 miles south of Curumbá, and about 300 miles southwest of Chapada. I believe it may be a normal specimen of Cope's *D. aurea*, but it is impossible to decide the question at present, and probably impossible ever to determine.

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[1] The measurements in parentheses are of an adult male skull of *Eptesicus dorianus* from Supacay, Paraguay.

[2] Amer. Nat., XXIII, p. 138, Feb. 1889.

The long rump hairs indicate that *aurea* is not an albinism of *D. azaræ,* which is about all that can be said with certainty of its relationship. In referring above (p. 626) to *Dasyprocta aurea* I had in mind the form here described as

Dasyprocta variegata urucuma subsp. nov.

Type, No. 36918, ♀ ad., Urucum (near Curumbá) Matto Grosso, Brazil, Dec. 7, 1913; Leo E. Miller, Roosevelt Brazilian Expedition.

Upperparts dusky, the hairs annulated narrowly near the base with white, and apically broadly with yellow, the dark basal portion of the hairs more or less visible at the surface, particularly along the midline of the back; hairs of the rump lengthened, deep black with conspicuous yellowish white tips; underparts like the flanks, with a narrow midline of pale yellowish white; inside of limbs yellow, outside dusky, the hairs tipped with yellow; upper surface of hind feet deep black, of fore feet blackish, the hairs minutely tipped with yellow; soles of fore feet brown, of hind feet intense black.

Field measurements, total length, 570 mm.; tail, 20; hind foot, 120; ear, 30. Skull, total length, 102; condylobasal length, 93; zygomatic breadth, 48; interorbital breadth, 28.5; diastema, 26; maxillary toothrow, 17.6.

Represented by the type only, an old female, with the basal sutures of the skull ankylosed and the teeth greatly worn.

This form belongs to the *D. variegata* group, and hence requires no comparison with *D. azaræ.* On the other hand, it is obviously more nearly related to *D. variegata yungarum* Thomas, from Yungas, Bolivia, than to any other described form, from which it appears to differ in somewhat smaller size and less ochraceous coloration.

59.82

Article XXIII.— DIAGNOSES OF APPARENTLY NEW COLOMBIAN BIRDS. IV.

By Frank M. Chapman.

This is the sixth [1] preliminary paper based chiefly on the results of our explorations in Colombia. Since the publication of the fourth paper of this series, Miller and Boyle have completed a very successful reconnaissance in Antioquia visiting parts of that region which had not before been reached by naturalists. Their collection contains a number of new and interesting forms, and, in connection with Miller's photographs and careful field notes, it is particularly valuable for the light it throws on distributional problems.

Meanwhile the study of our Colombian collections as a whole has been continued unremittingly, and it is hoped that the final report upon them will be concluded during the coming year.

Cordial acknowledgments of my indebtedness for the loan of material used in the preparation of this paper are due Dr. C. W. Richmond, of the U. S. National Museum; Mr. Outram Bangs of the Museum of Comparative Zoölogy; Mr. W. E. Clyde Todd, of the Carnegie Museum, and Mr. Thomas E. Penard of Arlington, Mass.

As in the preceding papers of this series, the nomenclature of Ridgway's 'Color Standards and Nomenclature' (Washington, 1912) has been employed.

Crypturus soui caquetæ subsp. nov.

Char. subsp.— Most nearly resembling *C. s. mustelinus* Bangs, the underparts, in the female, largely rich ochraceous-orange, the chest chestnut, the throat usually tinged with, and sometimes wholly ochraceous; the upperparts much darker, deep chestnut-brown rather than Prout's-brown; the crown slaty black without brownish tinge; male resembling female above, but not unlike male of *C. s. soui* below.

Type.— No. 115608, Am. Mus. Nat. Hist., ♀ ad., Florencia (alt. 675 ft.), Caquetá, Col.; L. E. Miller.

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[1] References to the five preceding papers follow: (1) Diagnoses of Apparently New Colombian Birds, Bull. A. M. N. H., XXXI, 1912, pp. 139–166; (2) Diagnoses of Apparently New Colombian Birds, II, XXXIII, 1914, pp. 167–192; (3) Diagnoses of Apparently New Colombian Birds, III, XXXIII, 1914, pp. 603–637; (4) Descriptions of Proposed New Birds from Central and South America, XXXIV, 1915, pp. 363–388; (5) The More Northern Species of the Genus *Scytalopus* Gould, The Auk, XXXII, 1915, pp. 406–423.

Remarks.— There unfortunately appears to be no name applicable to the bird inhabiting Amazonian Colombia, and doubtless eastern Ecuador. This race, however, is so well-marked that it cannot well be placed under any described form known to me. The characters, as usual, in this group, are best shown by the female of which we have two. Both these birds agree in their intensity of color and in having the lower throat-band rich chestnut, a character which, so far as I am aware, is shown by only one other race of this species— *C. s. mustelinus.* Of the latter form I have four topotypical females, not one of which approaches the Florencia females in the deep color of the upperparts and slaty blackness of the crown.

A male of *caquetæ* from La Muralla differs above from a male of *mustelinus* much as do the females of these races from one another, and is darker than the male of any form of *soui* known to me.

The faunal diversity of Colombia is indicated by the fact that it appears to be necessary to refer our specimens of *Crypturus soui* from that country to no less than 5 forms, all of which are practically restricted to the Tropical Zone. Of these *C. s. caucæ* is the least satisfactory since it appears to have no characters of its own and still cannot well be referred to any other form. The male is very near that of *modestus* and the female equally near that of *soui.* Since, however, neither of these names could properly be applied to it, it may for the present, at least, stand under the name I have suggested. With this far from acceptable compromise the races of *soui* in Colombia appear to be distributed as follows:

1. *Crypturus soui soui.*— From the eastern base of the Eastern Andes, north of the Guaviare River, eastward.
2. *C. s. caquetæ.*— Eastern base of the Eastern Andes from the Guaviare River southward and eastward.
3. *C. s. mustelinus.*— Santa Marta region (and also other portions of the arid coastal zone?).
4. *C. s. caucæ.*— Cauca and Magdalena Valleys.
5. *C. s. modestus.*— Pacific coast region south into western Ecuador, north to Nicaragua.

Crypturus kerriæ sp. nov.

Char. sp.— Most nearly related to *Crypturus boucardi,* but upperparts more barred and anteriorly browner; throat grayer, neck and breast blackish rather than gray, rest of underparts deeper, the breast slightly, the flanks conspicuously barred; size smaller.

Type.— No. 123204, Am. Mus. Nat. Hist., ♀, Baudo, Chocó, Colombia, July 3, 1912; Mrs. E. L. Kerr.

Description of Type.— Crown, nape, and sides of the head sooty black; hindneck and forehead dark chestnut passing into black or fuscous-black on the back, upper tail-coverts, tail, and exposed surfaces of the wings, all of which are distinctly and evenly barred with tawny, which is paler and more ochraceous on the wings; primaries and their coverts fuscous, unmarked except for slight marginal ochraceous-tawny spots near the ends of the inner ones; throat whitish becoming dusky on the neck; rest of underparts deep tawny, mixed with dusky on the breast, most of the breast feathers with partly concealed, small, broken, black bars; flanks with broad and conspicuous black bars which become less distinct on the ventral region; tibiæ and lower tail-coverts barred with black and tawny; feet horn-color; maxilla blackish, mandible whitish, darker at the tip and along the commissure.

Wing, 149; tail, 44; tarsus, 53; culmen, 29 mm.

Remarks.— I have named this apparently distinct species in honor of Mrs. Elizabeth L. Kerr, the collector of the type and only known specimen, whose work in the Atrato Valley has added materially to our knowledge of the avifauna of that part of Colombia.

As an evident representative of *Crypturus boucardi,* a species unknown south of Costa Rica, *Crypturus kerriæ* emphasizes the close faunal relation existing between the bird-life of western Colombia and that of Central America.

Tachytriorchis albicaudatus exiguus subsp. nov.

Char. subsp.— Closely resembling *T. a. sennetti* (Allen) but notably smaller with the upperparts, particularly the head and sides of the neck, darker and more slaty.

Type.— No. 130614, Am. Mus. Nat. Hist., ♂ ad., Barrigon, head of Rio Meta, Colombia; Manuel Gonzalez.

Remarks.— A specimen from Maripa, lower Orinoco, Venezuela, agrees essentially with the type. As stated in the preceding diagnosis, this form closely resembles *T. a. sennetti* and it is therefore quite unlike true *albicaudatus* of southern Brazil. Adults of the latter have the upperparts much darker (fuscous rather than grayish or slaty) while the chin and throat are wholly blackish, instead of pure white or white with some mixture of slaty. When fully adult, *sennetti* (of which we have a large series) has the entire underparts, including the throat, pure white. Both my specimens of *exiguus* are adult, one is almost without indication of bars on the tibiæ and abdominal region, the other is but slightly barred on these parts, but in each the throat is mixed slaty and white, and I am inclined to regard this marking as an approach toward *albicaudatus* rather than an indication of immaturity. This point can be settled, however, only by additional specimens.

Doubtless the form here described occurs also in British Guiana. I am aware that Brabourne and Chubb (Bds. S. A., I, p. 66) 'suggest British Guiana' as the type-locality for *albicaudatus,* but it seems to me beyond question that the bird described by Vieillot (Nouv. Dict. d'Hist. Nat., IV, 1816, p. 66) is the large, black-throated form of southern Brazil to which, furthermore, Dr. Allen in his description of *sennetti* (Bull. A. M. N. H., V, 1893, p. 144) in a sense restricted Vieillot's name.

Other names which have been applied to this species are also applicable to the southern form for which, since it was first made known by Azara, Paraguay may well be considered the type region.

Measurements of Adult Males.

Name	Place	Wing	Tail	Culmen
Tachytriorchis a. sennetti	San Patricio Co., Tex.	408	171	37
" " "	Corpus Christi, "	405	171	36.5
" " "	Bee Co., "	420	174	36.5
" " "	Tepic, Mexico	425	188	35
" " *exiguus*	Barrigon, Col. (Type)	395	151	32
" " "	Maripa, Ven.	383	148	32
" " *albicaudatus*	Matto Grosso, Brazil	418	175	32
" " "	" " "	405	165	32

Herpetotheres cachinnans fulvescens subsp. nov.

Char. subsp.— Similar to *H. c. cachinnans* (Linn.) but smaller and more richly colored; the upperparts and wings externally darker (dark sepia); the underparts, crown, nape, upper tail-coverts and under wing-coverts nearly uniform cinnamon-buff, instead of white washed with light buff; the crown more streaked, the lower wing-coverts more spotted.

Type.— No. 132991, Am. Mus. Nat. Hist., ♂ ad., Alto Bonito (alt. 1500 ft.), west slope, W. Andes, Antioquia, Colombia; Miller and Boyle.

Range.— Tropical Zone of the Pacific coast of Colombia southward at least to Puna Island, Ecuador, northward through Panama possibly to Nicaragua.

Remarks.— While my material clearly shows the existence of a well-marked, small, dark form of *Herpetotheres* in western Colombia and Ecuador, it by no means adequately represents the species as a whole. Three specimens in the Penard collection from Surinam, which Berlepsch (Nov. Zool., XV, 1908, p. 290) has designated the type-locality of true *cachinnans*, enables me to determine that all Colombian specimens from east of the Western Andes (Cauca Valley, Honda, Santa Marta, Villavicencio) are referable to that form, but in Central America the case becomes more complicated.

Apparently the form for which I here propose the name *fulvescens* extends northward to Panama (Canal Zone) whence we have two fairly typical specimens. Nicaragua and Honduras specimens show an increase in size but in color seem to be nearer *fulvescens* than to *cachinnans*, but Mexican specimens apparently differ from true *cachinnans* only in being somewhat larger. If this be true we should have the northern part of the range of *cachinnans* separated by the range of *fulvescens*. Doubtless, as in similar cases, a larger amount of material aided by a knowledge of the fact that the light forms of *cachinnans* which inhabit Mexico and South America (except the Pacific coast) do not come into actual contact will result in the separation of the Mexican bird.

Specimens examined.— *Mexico:* Jalisco, 2; Tepic, 1; Tlacotalpam, 1; Honduras, 1; Nicaragua, 2; *Panama* (Zone), 2; *Colombia:* Santa Marta, 4; Honda, 2; Villavicencio, 1; Barrigon, 1; Rio Frio, 1; Alto Bonito, 1; San Jose, 2; Barbacoas, 1; *Ecuador*: Manavi, 2; Puna Island, 1; *Venezuela:* Delta Orinoco, 1; Surinam, 3.

Measurements of Females.

	Wing	Tail
Villavicencio, Colombia	287	211
Santa Marta, "	283	223
" "	272	196
Barbacoas "	250	188
San Jose "	260	187
Panama	269	190
Jalapa, Nic.	278	210
Roman River, Honduras	280	228
La Canas, Jalisco, Mex.	300	231
La Laga, " "	303	246
Amatlan, Tepic "	300	233

Measurements of Males.

	Wing	Tail
Barrigon, Col.	272	217
Manavi, Ecuador	268	193
" "	256	178
San Jose, Col.	248	185
Alto Bonito, Col.	265	195
Tlacotalpam, Mex.	275	213

Aulocorhynchus albivitta griseigularis subsp. nov.

Char. subsp.— Similar to *A. a. phæolæmus* (Gould) but the throat gray with a faint bluish tinge instead of deep grayish blue; distinguished from *A. a. albivitta* by the color of its throat, by the greater width, apically, of the blackish stripe on the maxilla, and (in skins) by the absence of reddish at the end of this stripe and tip of the mandible.

Type.— No. 133272, Am. Mus. Nat. Hist., ♂ ad., Santa Elena (alt. 9000 ft.), Cen. Andes, Antioquia, Col., Dec. 2, 1914; Miller and Boyle.

Range.— Subtropical Zone of the western slope of the Central Andes and northern end of the Western Andes of Colombia.

Remarks.— Our series of forty-two specimens of *Aulocorhynchus albivitta* clearly shows that there are three well-marked forms of this species in the Subtropical Zone of Colombia. True *albivitta* is found in the Eastern Andes and eastern slope of the Western Andes; *griseigularis* inhabits the western slope of the Central Andes and we have also one specimen from an altitude of 10,000 feet on the Paramillo at the northern end of the Western Andes; while *phæolæmus* is confined to the Western Andes.

The three forms may readily be distinguished by the color of the throat which is nearly white in *albivitta,* gray in *griseigularis,* and grayish blue in *phæolæmus.*

The Santa Marta bird, *A. lautus,* appears to be specifically distinct. It has the throat of the same color as in *griseigularis* but the bill is differently shaped and colored, the maxilla being sulcate below the narrower culmen, on the base of which the black extends much further. There is no red whatever on the bill, and its white basal margin is bordered posteriorly with yellow.

Hellmayr (P. Z. S., 1911, p. 1213) has already called attention to the applicability of Gould's name *phæolæmus* to the form of the Western Andes, showing also that Gould erroneously referred Venezuelan specimens to this form and that a further error has been made (Cat. Bds. B. M., XIX, p. 158) in designating a Venezuelan specimen as Gould's type.

In view of my lack of specimens from Concordia, the type-locality of *phæolæmus,* and of the occurrence of the bird for which I have here proposed the name *griseigularis* at the northern end of the Western Andes, it may be questioned whether the Concordia bird is referable to the blue-throated or gray-throated race. Gould's description of *phæolæmus* as having the "throat deep grayish blue" can apparently, however, apply only to the more southern form, later described by Bangs as *A. petax,* of which I have topotypes from San Antonio.

Our ten specimens of *griseigularis* are from the following localities: Paramillo, 1; Sta. Elena, 4; Salento, 3; Miraflores, 2.

Picumnus granadensis antioquensis subsp. nov.

Char. subsp.— Similar to *P. g. granadensis* but whole breast grayish, the flanks and abdominal region distinctly streaked. Differs conspicuously from all the races of *P. olivaceus* in being less yellow throughout.

Type.— No. 133352, Am. Mus. Nat. Hist., ♂ ad., Peque (5000 ft.), Western Andes, Antioquia, Colombia; Miller and Boyle.

Remarks.— This form is based on a male and female from Peque and a male from the vicinity of Medellin presented to the American Museum by Francisco Escobar, Colombian Consul-General at New York. Its strongly marked characters are particularly well shown by this last-named specimen which leads to the conclusion that the male and female examples "f" and "g" recorded by Hargitt (Cat. Bds. B. M., XVIII, p. 549) from Medellin as *Picumnus granadensis* and later identified by Hellmayr (*cf.* P. Z. S., 1911, p. 1189) should be referred to this race.

Of true *granadensis* I have ten specimens of which two from San Antonio may be considered as topotypes; while two others from Los Cisneros may be considered equally topotypical of *Picumnus canus* Bangs (Proc. Biol. Soc. Wash., 1910, p. 72) which, as Hellmayr (P. Z. S., 1911, p. 1190) has shown, is a pure synonym of *granadensis.*

Although in pattern of marking *antioquensis* approaches the *olivaceus* type, and thus to some extent bridges the wide difference between *granadensis* and *olivaceus,* I nevertheless feel that the two forms are specifically distinct.

The reason for this belief will be given in connection with the treatment of the Colombian forms of *Picumnus olivaceus* in my final report.

Conopophaga castaneiceps chocoensis subsp. nov.

Char. subsp.— Similar to *C. c. castaneiceps* but much darker, wings and tail shorter but bill longer; male with the back mummy-brown with an olivaceous cast instead of deep neutral gray (with an olivaceous wash in immature specimens); crown chestnut instead of Sanford's brown, this color darker posteriorly but reaching as far back as the crown-cap in *castaneiceps;* underparts dark mouse-gray in place of deep neutral gray; the center of the belly whitish, the flanks heavily washed with olivaceous.

Apparently nearer *C. c. brunneinucha* Berl. & Stolz. of Peru but chestnut of crown evidently more extensive and size smaller. Wing, 68; tail, 39; tarsus, 29; culmen 15 mm.

Type.— No. 123321, Am. Mus. Nat. Hist., ♂ ad., Baudo Mts. (3500 ft.), Choco Colombia; July 18, 1912; Mrs. E. L. Kerr.

Remarks.— Although I have only the type of this species its characters, as compared with *C. c. castaneiceps,* are so pronounced that I have no hesitation in describing it as distinct from that race. Furthermore, I have two females from La Frijolera on the western slopes of the Central Andes above the lower Cauca which, in being generally darker and in having more olive on the flanks, are obviously intermediate between *chocoensis* and *castaneiceps.* A female recorded from La Selva (4600 ft.) on the headwaters of the San Juan River is also said by Hellmayr (P. Z. S., 1911, p. 1176) to have the back "rather more brownish than a Bogotá skin."

Unfortunately I have seen no specimens of *C. c. brunneinucha,* described by Berlepsch and Stolzman from Central Peru (P. Z. S., 1896, p. 385). While *chocoensis* appears to be nearer this race than to *castaneiceps,* the pileum and nape in the Peruvian bird are said to be of the same color as the back, whereas in *chocoensis* as well as *castaneiceps* they are essentially the same color as the forehead. Doubtless a comparison of specimens would reveal other differences. Meanwhile the two races can apparently be distinguished by size alone, as the appended measurements of males indicate.

Name	Place	Wing	Tail	Tarsus	Culmen
C. c. chocoensis	Baudo, Col.	68	39	29	15
" " *brunneinucha*	Peru (ex Berl. & Stolz.)	78	49	28.5	12.75
" " *castaneiceps*	Buena Vista, Col.	73	42	29	12.5
" " "	" "	71	41	28	13
" " "	" "	71	41	30	12.5

Microbates cinereiventris magdalenæ subsp. nov.

Char. subsp.— Differing from both *M. c. cinereiventris* and *M. c. torquatus* in having the tail tipped with whitish, the color both above and below paler, the tail, and particularly bill, longer; differs from *cinereiventris,* its nearest geographic ally, and agrees with *torquatus,* in having no postocular spot. Wing, 55; tail, 30; tarsus, 24; culmen, 21.5 mm.

Type.— No. 133479, Am. Mus. Nat. Hist., ♂ ad., Malena (alt. 1000 ft.), near Puerto Berrio, Antioquia, Col., March 10, 1915; Miller and Boyle.

Remarks.— The discovery of this interesting race extends the species eastward to the Magdalena Valley. Although resembling *M. c. torquatus* of Panama and Costa Rica in the absence of a postocular mark, it is evidently wholly cut off from that race by *cinereiventris* to which form four specimens secured by Anthony and Ball in eastern Panama (Tacarcuna) are referable.

This proposed race is based on only the type, which has been compared with the type of *M. c. torquatus* and sixteen specimens of *M. c. cinereiventris,* including four from Barbacoas, which may be considered topotypical.

Xiphorhynchus lachrymosus alarum subsp. nov.

Char. subsp.— Similar to *X. l. lachrymosus* (Lawr.) but buffy, guttate spots on the back smaller and narrowly margined with black and more widely with Dresden-brown, rather than broadly margined with black; spots below averaging smaller; lesser wing-coverts with much less black, the outer greater coverts margined externally with brownish above instead of black.

Type.— No. 133599, Am. Mus. Nat. Hist., ♂ ad., Puerto Valdivia (alt. 360 ft.), Cauca River, Antioquia, Col., Dec. 18, 1914; Miller and Boyle.

Remarks.— Comparison of twelve specimens from the type-locality with twenty-eight specimens of *X. l. lachrymosus,* including the type, show that the characters on which this form is based are as constant as they are pronounced. The series of *lachrymosus* includes seven specimens from Dabeiba and Alto Bonito on the western slope of the Western Andes and the occurrence of this form in these localities further emphasizes the racial differences exhibited by specimens of certain species from the western and eastern slopes of this range.

Specimens from the type-locality of *X. l. rostratus* Ridgw. (Proc. Biol. Soc. Wash., 1909, R. Dagua) apparently show that it is not a valid race.

Siptornis flammulata quindiana subsp. nov.

Char. subsp.— Similar to *S. f. flammulata* (Jard.) of Ecuador but upperparts browner, the front part of the crown richer and deeper in tone, hazel rather than ochraceous-tawny, with, as a rule, the shaft-streaks broader, the margins correspondingly narrower; superciliary ochraceous and less clearly defined; throat deeper in tone, ochraceous-buff rather than buff, its color spreading to the breast, the sides of the head and auricular region; flanks and abdominal region more ochraceous. Differs from *S. f. multostriata* (Scl.) of the Bogotá region, in being less heavily margined with black below, the margins more even in outline, the throat-patch much larger and paler, the upperparts browner, the frontal region less chestnut and less distinctly streaked.

Type.— No. 112065, Am. Mus. Nat. Hist., ♂ ad., Paramo of Santa Isabel (12,500 ft.), Cen. Andes, Colombia, Sept. 20, 1911; Allen and Miller.

Range.— Paramo Zone of the Central Andes of Colombia.

Remarks.— This proposed race is based on comparison of fifteen specimens from Santa Isabel with ten from Pichincha and Chimborazo, and one from the Paramo of Choachí near Bogotá. The differences between *flammulata* and *quindiana* were at once recognized but in default of a topotypical specimen of *multostriata,* it was a question whether to follow Sclater (P. Z. S., 1869, p. 636) in considering the Bogotá form synonymous with *flammulata,* when the Santa Isabel race would require a name, or whether to accept the name *multostriata* for the Central Andean form.

This question was answered most satisfactorily by the receipt through Brother Apolinar Maria of a specimen from the Paramo of Choachí, some fifteen miles east of the city of Bogotá, which I assume is typical of *multostriata.* This specimen agrees with Sclater's description of *multostriata* (P. Z. S., 1857, p. 273) but is so unlike both the Ecuador and Santa Isabel races as to suggest its specific distinctness. The pattern of the upperparts agrees with that of *flammulata,* but the crown is more chestnut; the 'throat-patch' is confined largely to the chin, not reaching behind the gape, and is bright hazel or Sanford's-brown, sharply defined posteriorly; the remainder of the underparts are white, the feathers, quite to the crissum, being margined with black with usually a faint inner ochraceous margin. This margin is less even than in *flammulata* and *quindiana* and on most of the feathers of the abdominal region appears as paired, subterminal lateral spots which indent the median white area but do not reach to the shaft of the feather.

I observe that Brabourne & Chubb (Bds. S. Am., p. 236) use Sclater's name *multostriata* for the Ecuadorian as well as Colombian bird, presumably acting on the assumption that *Sittasomus flammulata* Less. (Tr. d'Orn., 1831, p. 315) is, as Sclater thought "very doubtful" (Cat. B. M., XV, p. 61), *Siptornis striaticollis* (Lafr.). Lesson's description alone does not seem to warrant this belief, but if it should prove to be correct, the Ecuadorian bird here referred to as *Siptornis flammulata flammulata* (Jard.), will require a new name.

The Choachí specimen is not sexed but its smaller size suggests that it is a female, and I have therefore compared it in size with females of the other two races.

Measurements.

Name	Place		Sex	Wing	Tail	Tarsus	Culmen
Siptornis f. multostriata,	Choachi,	Col.	?	59	69	24	14.5
" " *quindiana,*	Santa Isabel,	"	♀	63	75	26	15
" " "	"	"	♀	62	71	25	15
" " "	"	"	♀	66.5	78	25.5	14
" " "	"	"	♀	64	73.4	25.5	14
" " "	"	"	♀	66	80	25.5	15
" " *flammulata,*	Chimborazo,	Ec.	♀	64.5	75	24.5	14
" " "	Corazo,	"	♀	65	72	25.5	16
" " "	Pichincha,	"	♀	60	64.5	25	14

Automolus nigricauda saturatus subsp. nov.

Char. subsp.— Similar to *A. n. nigricauda* Hart. but very much darker; the back deep blackish bay instead of between raw-umber and mummy-brown, the crown and nape only slightly darker than the back, with more of a claret-brown tinge, which is clearer on the sides of the head; wings externally of the same color as the back, tail black; breast somewhat deeper than in *nigricauda,* the rest of the underparts darker brown, less olivaceous, the sides and particularly flanks much darker, nearly the color of the back.

Type.— No. 133571, Am. Mus. Nat. Hist., ♂ ad., Alto Bonito (alt. 1500 ft.), Antioquia, Col., Feb. 16, 1915; Miller and Boyle.

Range.— Northwestern Colombia and northward to eastern Panama (Tacarcuna).

Remarks.— Miller and Boyle collected five specimens of this strongly marked form at the type-locality and the succeeding month Anthony, Richardson and Ball took nine more at Tacarcuna in eastern Panama. The latter series, as a whole, is somewhat paler but is clearly not separable from the Colombian bird. Of *nigricauda* I have two west Ecuador specimens.

Automolus fumosus Salv. & Godm., known from one Chiriqui specimen, appears to be an intermediate between *nigricauda saturatus* and *A. veræpacis.* Judging from the description alone it is nearer the former above and the latter below. Wholly aside from other characters its black tail distinguishes *saturatus* from *A. rufipectus* and *A. cinnamomeigula.*

Manacus vitellinus milleri subsp. nov.

Char. subsp.— Similar to *M. v. vitellinus* (Gould) but male with the throat, breast, sides of the head and nape chrome rather than cadmium, posterior underparts olive-yellow rather than warbler-green; female paler below, the abdomen, particularly centrally, yellower.

Type.— No. 133857, Am. Mus. Nat. Hist., ♂ ad., Puerto Valdivia (alt. 360 ft.), lower Cauca River, Antioquia, Colombia; December 16, 1914; Miller and Boyle.

Range.— Probably humid portions of the Tropical Zone of the lower Cauca and Magdalena Rivers. Specimens from "Cauca, Remedios" recorded by Sclater and Salvin (P. Z. S., 1879, p. 517) as *M. vitellinus,* should doubtless be referred to this race.

Remarks.— Of this well-marked form Miller and Boyle secured an excellent series of seven males and five females at the type-locality which show, on comparison with a large series of *vitellinus,* that the characters attributed to the new form are constant.

The point to which its differentiation has been carried is all the more surprising when it is found that ten specimens collected by Miller and Boyle at Dabeiba and Alto Bonito in almost the same latitude as Puerto Valdivia, but on the western slope of the Western Andes, are typical of *vitellinus.* It is even more surprising to find that four males from the Cauca Valley, the fauna of which appears to have been derived through the course of the Cauca River, are referable to *vitellinus* rather than *milleri.*

I have named this strongly characterized race for Mr. Leo E. Miller, leader of our expedition to Antioquia, in recognition of the service he is rendering science through his continued explorations in South America.

Phyllomyias griseiceps caucæ subsp. nov.

Char. subsp.— Similar to *P. g. griseiceps* (Scl.) but upperparts much darker, the back olive washed with blackish and not clearly defined from the crown; size larger.

Type.— No. 109025, Am. Mus. Nat. Hist., ♂ ad., Miraflores (alt. 6400 ft.), E. of Palmira, Cen. Andes, Cauca, Col.; Chapman and Richardson.

Remarks.— It is obvious that two specimens of the genus *Phyllomyias* from the Subtropical Zone above the Cauca Valley are subspecifically separable from a Bogotá and two Santa Marta specimens. The latter agree in size with *P. griseiceps* Scl. (P. Z. S., 1870, p. 841) of western Ecuador, of which, unfortunately, I have no topotypical specimens. Both the male and female of *caucæ*, as the appended table shows, are, however, too much larger than *griseiceps* to be referred to that species, and at the risk of increasing the confusion which prevails in this group I reluctantly describe them.

Measurements.

Name	Place	Sex	Wing	Tail	Tarsus	Bill Length and	Breadth.
P. g. caucæ	La Manuelita, Col.	♂	57	49	16.5	8.5	6.5
" " "	San Antonio, "	♀	57	50.5	16.	—	—
P. g. griseiceps	W. Ecuador (ex Scl.)	—	50.8	48.2	—	—	—
" " "	Cunday, Bogotá region, Col.	—	53	48	14	8	5
" " "	Minca, Sta. Marta	—	50	44	14	8	5.2
" " "	" " "	♂	52	45.5	14	7.5	5

Habrura pectoralis bogotensis subsp. nov.

Char. subsp.— Similar to *H. p. pectoralis* but more richly colored throughout, the buffy areas of *pectoralis* largely ochraceous-tawny; the lores, margins to frontal feathers, auricular region, rump, wing-bars and quill margins ochraceous-tawny, the foreback blackish brussels-brown; crown black, margined with ochraceous tawny; underparts largely ochraceous-tawny, the throat and center of the abdomen yellowish buffy; a band of ochraceous-tawny crossing the breast; size between that of *pectoralis* and *brevipennis*. Wing, 44.5; tail, 40; tarsus, 17; culmen, 10 mm.

Type.— No. 132123, Am. Mus. Nat. Hist., Sex ?, Suba, Bogotá Savanna, Col., April 5, 1915; Hermano Apolinar Maria.

Remarks.— This is the fourth new bird taken in the marshes where I had the good fortune to shoot the types of *Ixobrychus exilis bogotensis* and *Agelaius icterocephalus bogotensis*, and from which Brother Apolinar secured the type of *Cistothorus apolinari*.

Evidently the native collectors who during the past eighty years have been shipping birds' skins from Bogotá have collected chiefly on the forested slopes of the Andes, neglecting the country at the city's gates.

Geographically, the nearest species of the genus *Habrura* to the one here described, is *Habrura pectoralis brevipennis* Berl. & Hart. (Nov. Zool., IX, 1902, p. 40), a small form of *pectoralis*, which it is said to resemble exactly in color, of the lower Orinoco and British Guiana and hence of the Tropical Zone. It follows, therefore, that as with *Agelaius icterocephalus bogotensis*, we have in the bird here described a form of a Tropical Zone species apparently isolated on the Temperate Zone Savanna of Bogotá.

This fact, in connection with the bird's degree of differentiation, suggests its specific distinctness, but although I believe that actual intergradation does not occur I feel that the bird's relationships are best expressed by a trinomial. We are indebted for the type and only specimen of this new form to Brother Apolinar Maria, Director of the Institute de la Salle, of Bogotá, whom we have to thank for invaluable coöperation in our study of the birds of that region.

It is to be hoped that Brother Apolinar will make exhaustive collections of the birds of the Bogotá Savanna, the only place, so far as I am aware, in the Temperate Zone of the Colombian Andes suitable for habitation by plains- and marsh-haunting birds.

Microcerculus squamulatus antioquensis subsp. nov.

Char. subsp.— Most closely resembling *M. squamulatus corassus* (Bangs), but averaging larger with a longer bill; underparts more strongly and definitely barred; upperparts, flanks, ventral region and under tail-coverts darker, more rufescent cinnamon-brown instead of Saccardo's umber.

Differing from *M. squamulatus tæniatus* (Salv.) in the color of the upperparts, flanks and ventral region as it does from *corassus*, and in having the feathers of the breast and upper abdomen basally black and more narrowly white subterminally. Differing from *M. squamulatus squamulatus* Scl. & Salv. in having the breast and upper abdomen regularly and sharply barred with black and white instead of being whitish, narrowly and weakly barred with blackish or whitish, more or less suffused with grayish or brownish and irregularly marked or mottled with broken bars, shaft-streaks or hastate-crescents of black.

Type.— No. 134006, Am. Mus. Nat. Hist., ♂ ad., Dabeiba (alt. 2000 ft.), Rio Sucio, Antioquia, Western Colombia; Feb. 26, 1915; Miller and Boyle.

Remarks.— Miller and Boyle sent two males of this form from Dabeiba and a third from Alto Bonito. For comparison I have one specimen of *M. s. tæniata,* four specimens of *M. s. corassus,* including the type loaned by Mr. Bangs, and two specimens from Don Diego, Santa Marta, from Mr. Todd, who also sends four specimens from Las Quigas, and one from La Cumbre, Venezuela, which I assume are *M. s. squamulatus;* though they were taken nearer the type-locality of *M. pectoralis* Rich. (Proc. U. S. N. M., XXIV, 1902, p. 178; La Guayra). There is, however, so much variation shown by this series, which contains individuals resembling Sclater's plate (P. Z. S., 1875, pl. vi) and Richmond's description, that I suspect *pectoralis* is not separable from *squamulatus.* I have not, however, seen topotypical specimens of the latter nor is their examination apparently essential in this connection, since the form here described seems to lie between *corassus* and *tæniata.* Its differences from the first-named have been sufficiently dwelt on. Examination of my single and topotypical specimen of *tæniata* shows that in this form the barring of the feathers of the breast and upper abdomen are white with a somewhat irregularly crescentic black bar across the terminal half which is succeeded by a white area equal to or wider than the black band, the tips being very narrowly, almost indistinguishably black. In *antioquensis* the feathers of the corresponding area are white with a concealed black bar or spot at the base, a well defined regularly circular one on the terminal half followed by a narrower white band with, as in *tæniata,* a very narrow black margin.

The various forms here mentioned are obviously races of one species, and for the present I have placed them under *squamulatus,* the first of the immediate group known. However, two specimens from eastern Panama strongly indicate intergradation of the barred breasted forms with *M. luscinea* of the Canal Zone and if, as Mr. Bangs surmises (Proc. Biol. Soc. Wash., XXII, 1909, p. 34) there is but one form in Central America, the entire group may stand as races of *M. philomela* (Salv.).

Measurements.

Name	Place	Sex	Wing	Tail	Tarsus	Culmen
M. s. antioquensis	Dabeiba, Col.	♂	59	22	24	20
" " "	" "	♂	55.5	20	21.5	20
" " "	Alto Bonito, "	♂	56.5	22	22	19
M. s. corassus	Don Diego, Sta. Marta	♂	53	19	21.5	17.5
" " "	" "	♂	60	23.5	22	19.5
M. s. squamulatus	Las Quiguas, Venez.	♂	60	23	22	19.5
" " "	" " "	♂	60	21	23	19
M. s. corassus	Sta. Marta, Col.	♀	56	21	22.5	17
" " "	Don Diego, Sta. Marta	♀	53.5	21	20.5	17
M. s. squamulatus	Las Quiguas, Ven.	♀	58	21.5	22	19
" " "	" " "	♀	58.5	20	22.5	19
" " "	La Cumbre "	♀	57.5	23	22	20
M. s. tæniata	Chone, Ecuador	♀?	55.5	20.5	23	19

Polioptila livida daguæ subsp. nov.

Char. subsp.— Similar to *Polioptila l. plumbeiceps* (Lawr.) but much darker above, the back, etc., slate-gray rather than gull-gray (No. 7), the inner wing-quills narrowly instead of widely margined with whitish, outer pair of tail-feathers white almost to the base; no indication of a superciliary.

Type.— No. 108286, Am. Mus. Nat. Hist., ♂ ad., Los Cisneros, Dagua River, west Colombia; March 20, 1911; W. B. Richardson.

Remarks.— Although I have but a single specimen of this proposed new race its characters are so well-marked when compared with sixteen specimens of *P. l. plumbeiceps* (including the type), and, furthermore, are so in keeping with those shown by other subspecies from the humid Pacific coast, that I have no hesitation in describing it.

Cisneros, the type locality for this form, marks the known westward limit of the *Polioptila livida* group.

Sporophila aurita murallæ subsp. nov.

Char. subsp.— Most nearly related to *S. a. ophthalmica* but larger throughout, the black breast-band averaging narrower (nearly incomplete in one specimen), sides grayer, white patch at base of primaries smaller, lesser wing-coverts narrowly tipped with white, greater ones less frequently with white near the end of shaft.

Type.— No. 117054, Am. Mus. Nat. Hist., ♂ ad., La Muralla (alt. 600 ft.), Caquetá, Colombia; July 11, 1912; L. E. Miller.

Remarks.— This race is based on the comparison of three adult males from the type-locality with fourteen from the coast of Ecuador. Its close relationship to the Pacific coast race emphasizes the faunal affinity of the Tropical Zone at the eastern and western bases of the Andean system; while its characters mark an evident approach toward *Sporophila lineata* of lower Amazonia, suggesting that that species may form a link in the somewhat remarkable chain composing the *sporophila-aurita* group.

Measurements of Males.

Name	Place	Wing	Tail	Tarsus	Culmen
Sporophila a. murallæ	La Muralla, Col.	59	47	17.5	12.5
" " "	" "	58.5	44	17.5	13
" " "	" "	61	47.5	16	12.3
S. a. ophthalmica	Daule, Ecuador	55	41.5	15.5	11.3
" " "	" "	53	43.5	16.7	11.3
" " "	" "	54	43	15.3	11
" " "	" "	54	42	16.5	11
" " "	" "	54	43.5	16	12

Catamenia analoides schistaceifrons subsp. nov.

Char. subsp.— Similar to *C. a. analoides* (Lafr.) but smaller, the male with the forehead, lores and chin slaty or gray and without black, the throat and breast much paler, pale neutral gray rather than slate-gray; white area on the primaries at the end of the primary coverts wholly absent or barely suggested; margins of wing-coverts and inner margins of wing-quills grayer.

Type.— No. 126670, Am. Mus. Nat. Hist., ♂ ad., La Mar (alt. 8260 ft.), Cundinamarca, Col., June 13, 1913; Manuel Gonzalez.

Remarks.— This form is based on an adult and immature male from the type-locality, and a female from Suba in the Bogotá Savanna. For comparison I have two adult males and one immature female, topotypes of *analoides* from Lima, and four adult males from Ecuador (Chimborazo; 'Quito'). The latter agree with *analoides* rather than with *schistaceifrons*, though in their reduced size and smaller amount of black about the base of the bill they show an approach toward the Colombian form.

In this form the differentiation from *C. analis* of Bolivia, shown in part by *C. analoides*, is evidently carried to its extreme through the disappearance of black about the base of the bill and of the loss of the white speculum.

Measurements.

Name	Locality	Sex	Wing	Tail	Culmen
Catamenia a. analoides	Lima, Peru	♂	66.5	55	8
" " "	" "	♂	67	54.5	8
" " "	Chimborazo, Ec.	♂	61.5	48	8.5
" " "	" "	♂	62	53.5	8.5
" " "	" "	♂	62	51.5	8.5
Catamenia a. schistaceifrons	La Mar, Col.	♂	63	54	9
" " "	" "	♂	60	50.5	9

The Northern Races of Phrygilus unicolor.

This Finch appears to be one of the most common and characteristic species of the Paramo or Alpine Zone in Colombia and Ecuador, below which we have not found it. Ranging from Chile to the Santa Marta Mts., Colombia and Andes of Merida, Venezuela, where this zone finds its northern limit, it is subject to much variation in size. This variation is progressive from Peru both northward and southward since, as Sharpe (Cat. Bds. B. M., XII, p. 793) shows, specimens from both Ecuador and Chile are larger than those from Peru. But from central Colombia northward and eastward a decrease in size occurs. In default of series from south of Ecuador I can throw no light on variations of this bird in the southern part of its range. From Ecuador, however, I have 28 specimens, from Colombia 34, and from Venezuela, 7.

In size these 69 specimens obviously fall into two groups. The first inhabits the Andes of Ecuador and the Central Andes of Colombia, a natural faunal association. The second inhabits the Eastern Andes of Colombia, and their extension into Venezuela, and also the Santa Marta group.

Thirty-three adult males in fresh, unworn plumage are more uniformly clear slate-gray both above and below, than those in worn plumage. In the latter plumage the upper and underparts have a brownish wash and the frayed edges to the feathers of the back become grayish. In both fresh and worn plumages there is occasionally an indication of black shaft-streaks. This occurs in specimens from both Ecuador and Colombia and is possibly due to immaturity, since this character is more or less pronounced in the plumage of the immature male. I can detect no racial differences in color in our series of males from Ecuador, Colombia and Venezuela. Freshly plumaged birds from the Paramo of Chiruqua, Santa Marta, being absolutely matched by freshly plumaged birds from Chimborazo. Similarly, males in worn plumage from near Merida agree with males in similar plumage from Santa Isabel.

Not one of the nineteen freshly plumaged adult males in this series (Chimborazo, 16; Santa Marta, 3) is as dark, particularly below, as a single freshly plumaged male of true *unicolor* from Limbana, Peru. This difference is marked and apparently of racial value, and, aside from differences in size, appears to warrant the conclusion that in representatives of *Phrygilus unicolor* from at least Chimborazo northward, males can be distinguished in color from males of true *unicolor*. I have seen no females of *P. u. unicolor*.

The variations shown by my series of females are much greater than those presented by the males. They are attributable to age, fading, and wear and occasion such marked differences in color and in pattern of marking that it is most difficult to determine the extent and constancy of the limited amount of racial variation the series as a whole exhibits.

Freshly plumaged birds have the brown margins above and whitish margins below wider and are less sharply streaked, particularly below, than those in worn plumage. Immature birds have the breast more or less suffused with buffy and the colors throughout richer. After making due allowance for these individual variations, and using also the character of size, I can distinguish at least three races, the diagnostics and ranges of which are given below:

Phrygilus unicolor grandis subsp. nov.

Char. subsp.— Larger and with a longer, heavier bill than any known race of the species; male paler, particularly on the underparts, which have a whitish cast, than the male of *P. u. unicolor* (Cab.), which is nearly the same color below as above; female with the auricular region usually grayish or tinted with buffy instead of dark olive-buff as in *P. u. geospizopsis* (Bonap.); not certainly distinguishable in color from the much smaller *P. u. nivarius* (Bangs).

Type.— No. 112797, Am. Mus. Nat. Hist., ♂ ad., Paramo of Santa Isabel (alt. 12700 ft.), Central Andes, Columbia; Sept. 20, 1911; Allen and Miller.

Range.— Alpine or Paramo Zone of Ecuador and the Central Andes of Colombia.

Remarks.— As the appended table shows, this race is characterized by its large size, which is not equalled by that of any other known race of the species. Females from Santa Isabel in juvenal plumage are noticeably more chestnut above and more buffy below than Ecuador birds in similar plumage. To a lesser degree the same differences are present in birds in worn plumage; but individual variation in this sex is so great that an even larger series than I possess is necessary properly to appraise these differences.

Some Ecuador birds show traces of the olive-buff auriculars which appear to characterize *geospizopsis,* but this feature is not present in Santa Isabel specimens.

Specimens examined.— *Colombia:* Santa Isabel, 8 ♂ ads., 3 ♂ im., 3 ♀ ads., 2 ♀ imm. *Ecuador:* Chimborazo, 16 ♂ ads., 5 ♂ imm., 1 ♀ ad., 4 ♀ imm.; Qyito, 1 ♀ ad.

Phrygilus unicolor geospizopsis (*Bonap.*)

Passerculus geospizopsis Bonap., Compt. Rend., XXXVII, 1853, p. 921 (Colombia = 'Bogota,' *cf.* Sclater, P. Z. S., 1855, p. 160).

Char. subsp.— Distinguished from *P. u. grandis* Chapm. by its smaller size, from *P. u. nivarius* by its larger size; from both *grandis* and *unicolor* by its olive-buff, instead of grayish or buffy auricular region and by the suffusion of olive-buff on the chin and throat in the female.

Range.— Alpine or Paramo Zone of the Eastern Andes, Colombia.

Remarks.— Thanks to the kind offices of Hermano Apolinar Maria, I am in possession of nine topotypical specimens of this currently unrecognized race, from the Paramo of Choachí near Bogotá. Of six adult females taken in October and November, and in partly worn plumage, all but one have the auricular region and throat markedly buffy-olive, a character which appears to distinguish this species. At any rate, it is not present in other Colombian specimens, though it is shown by some from Chimborazo. Should it prove to be individual or seasonal this form would differ from other northern forms of this group by size alone.

Specimens examined.— *Colombia:* Paramo of Choachí, 3 ♂ ads., 6 ♀ ads.

Phrygilus unicolor nivarius (*Bangs*).

Haplospiza nivaria Bangs, Proc. Biol. Soc. Wash., XIII, 1899, p. 102 (Paramo de Chiruqua, alt. 15,000 ft., Santa Marta Mts., Col.— Type examined).

Haplospiza montosus Riley, Proc. Biol. Soc. Wash., XVIII, 1905, p. 220 (San Antonio, near Merida, Venezuela.— Type examined).

Char. subsp.— Distinguished from *P. u. geospizopsis* (Bonap.) by its smaller size (at least in the male) and by its grayish, instead of buffy olive auricular region; distinguished from *P. u. grandis* by its smaller size.

Range.— Alpine Zone of the Santa Marta group and Andes of Merida, Venezuela.

Remarks.— Through the kindness of Mr. Bangs I have before me the type and eight topotypes of this race. All were taken in October and November. The latter, therefore, are in more worn and consequently not comparable plumage, though it does not seem probable that the olive-buff ear and throat color of *geospizopsis* can be due to wear.

"*Haplospiza montosus*" of Riley is based on August specimens in worn plumage in which the streaks of the underparts are strongly emphasized. A June female from near the type locality of *montosus* is in comparatively fresh plumage and does not differ essentially from the Santa Marta birds which indeed can be nearly matched by an August topotype of *montosus* in our collection.

So far as color is concerned, therefore, I am convinced that there is no more differences between Santa Marta and Merida birds than there is between Santa Marta and Santa Isabel birds. The Bogotá bird seems to stand alone with its olive-buff suffusion on the ear coverts and throat.

As for size, while there appears to be no constant difference between males from Santa Marta and Merida, some Merida females have the wing and tail decidedly shorter than in Santa Marta birds. The three Merida birds showing this difference are, however, all August specimens in worn plumage and their apparent small size is, in a measure at least, due to their worn condition.

The table of measurements of all females is rendered somewhat unreliable by evident inaccuracy in sexing. The male appears to wear the plumage of the female until at least its first breeding season and during this period can be distinguished externally from the female by size alone. This fact should be taken into consideration in connection with the apparent discrepancy shown by certain measurements of supposed females.

Specimens examined.— *Colombia:* Paramo de Chiruqua, Santa Marta, 5 ♀ ads.; 3 ♂ ads., 1 ♂ im. *Venezuela:* 3 ♂ ads.; 5 ♀ ads.

The Limits of the Genus Phrygilus.— The reference by previous authors of certain forms of *Phrygilus unicolor* to *Haplospiza* may be considered to express their belief that this species is not properly referable to the genus *Phrygilus,* of which *P. gayi* is the type. With this opinion I agree, but it seems equally obvious that *unicolor* is not referable to *Haplospiza,* from which it differs in its less acutely pointed bill and more pointed wing; the outer primary being longer instead of shorter than the sixth (from without). Doubtless we shall eventually refer it to *Geospizopsis* Bonap., of which the bird I have here called *Phrygilus unicolor geospizopsis* is the type. I am not prepared to adopt this course, however, without an examination of all the species of the group.

Measurements of Males.

Locality	Wing	Tail	Tarsus	Culmen
Limbana, Peru	88	60.5	22.5	13
Mt. Chimborazo, Ec.	90	64	25	14
" "	95.5	64.5	25	15
" "	93.5	65.5	26	14
" "	93	66	25	15
Santa Isabel, Col.	92	64	26.5	15.5
" "	93	64	27	15
" "	90.5	64.5	26	15
" "	89	64	27	14.5
" "	90	62.5	25	14.5
" "	88.5	64.5	26.5	14.5
" "	95.5	70	27.5	15.5
Choachí, Col.	88.5	60.5	24	13.5
" "	86.5	61	24	14
" "	89	59	24.5	14
Near Merida, Ven.	82	53.5	23.5	14
" "	80	59	23.5	13.5
Santa Marta Mts., Col.	83.5	—	22.5	14
" " "	83.5	60	22.5	13
" " "	83.5	60	23	13

Measurements of Females.

Locality	Wing	Tail	Tarsus	Culmen
Mt. Chimborazo, Ec.	88	60	25	14.5
" "	86.5	62.5	26	14.5
Santa Isabel, Col.	88	63	28	15
" "	90.5	64	27	16
" "	88	63	26	16
Choachí, Col.	81	56.5	24	14.5
" "	79	55	24	14
" "	79	54	24	13.5
" "	79	55	22.5	13
" "	79	57	23.5	13.5
Near Merida, Ven.	77	56	24	13.5
" "	81	61	25	13.5
" "	71	53	22.5	13.5
" "	71	52	21.5	13.5
" "	71	52	22.5	14
Santa Marta Mts., Col.	82	57	23	13
" " "	81	57	22.5	14
" " "	81	57	22.5	13
" " "	81	58	22.5	13
" " "	78	55	21	13
" " "	80	58	21	13

Cyanerpes cyaneus pacificus subsp. nov.

Char. subsp.— Similar to *C. c. cyaneus* (Linn.) but male with the turquoise crown-cap slightly darker, bluer in color and smaller in area, the blue band of the nape correspondingly wider, the inner margins of the wing-quills and under wing-coverts pale citron-yellow rather than canary-yellow; female darker, less yellowish green above, the under wing-coverts and inner margins of wing-quills much paler than in the female of *cyaneus*, straw-yellow rather than canary-yellow. More closely related to *Cyanerpes cyaneus gigas* (Bangs & Thayer) of Gorgona Island off the Colombia coast, which it resembles in the pale wing-lining, but wings and tail averaging longer, blue of the male less purple, particularly on the rump, the female not so dark above or so yellow below.

Type.— No. 118227, Barbacoas, Dept. Narino, Colombia; ♂ ad., Sept. 1, 1912; W. B. Richardson.

Remarks.— When Thayer and Bangs described *Cyanerpes gigas* from Gorgona Island (Bull. M. C. Z., XLVI, 1905, p. 96) no form of *Cyanerpes cyaneus* had been recorded from the Pacific coast of South America and the occurrence of a representative of this species on an island off southwest Colombia was most unexpected. The species, however, appears to be not uncommon, at least from Buenaventura southward, and the form occupying this area, in its somewhat greater dimensions and darker female, approaches *gigas*, but the male of *pacificus* agrees in the color of the blue parts with the male of *cyaneus* and does not therefore show the more purplish color which distinguishes the type of *gigas*. The type of *gigas*, which, thanks to Mr. Bangs, I have examined, is, however, not fully adult and its comparatively deep purplish blue may be due to immaturity. But this theory is not supported by an examination of specimens of *Cyanerpes cyaneus cyaneus* in plumage corresponding to that of the type of *gigas*, since in them the blue areas appear to be of the same shade as in the adult.

The differences in color and size between the females of *pacificus* and *gigas* are constant in five specimens of the former and one of the latter examined. Both forms agree and differ alike from true *cyaneus* in their much paler under wing-coverts and wing-lining, though the high humidity of the region they inhabit, with a rainfall probably not equalled by that of any other part of South America would lead one to look for intensification rather than a reduction in the color of the forms which characterize this area.

For a species which has not heretofore been recorded from the Pacific coast of South America the number of specimens of this form of *Cyanerpes cyaneus* here described which we have collected in that region, indicates how much work remains to be done even in the parts of South America which we consider fairly well explored, before we can claim an approximately complete knowledge of their avifauna. A list of our specimens follows:

Colombia: Buenaventura, 1 ♂, 1 ♀; San José, 2 ♂♂; Los Cisneros, 1 ♂, 1 ♀; Barbacoas, 3 ♂♂, 3 ♀♀; Tumaco, 1 ♂. *Ecuador:* Esmeraldas, 1 ♂; Manavi, 1 ♂.

Measurements.

Name	Place	Sex	Wing	Tail	Culmen
C. c. pacificus,	Barbacoas, Col.	♂	67	38	16.5
" " "	" "	♂	69	40	17
" " "	" "	♂	67	39	16
" " "	Tumaco, "	♂	70	41	15.5
" " "	Los Cisneros, "	♂	67	41	17
C. c. cyaneus	Demarara, B. G.	♂	64	37	17
" " "	" "	♂	60	35	15
" " "	Trinidad, B. W. I.	♂	66	37.5	18
" " "	" "	♂	66	38	19
C. c. eximia	Bonda, Sta. Marta,	♂	67	39	18
" " "	" "	♂	65	39	19
" " "	" "	♂	65	38	18.5
" " "	" "	♂	66	39	19
C. c. gigas [1]	Gorgona Island, Col.	♂	68.5 [2]	42	16
" " "	" " "	♂	66 [2]	43	16.5
C. c. pacificus	Buenaventura, "	♀	64	38.5	17.5
" " "	Los Cisneros, "	♀	65.5	38	17.5
" " "	Barbäcoas, "	♀	65	39	16.5
" " "	" "	♀	62	36.5	17.5
" " "	" "	♀	66	40.5	18
C. c. gigas	Gorgona Island, "	♀	67.5	42.5	—

Iridosornis dubusia ignicapillus subsp. nov.

Char. subsp.— Similar to *I. d. dubusia* (Bonap.) of the Bogotá region but with the crown-patch orange-chrome or cadmium-orange instead of cadmium-yellow with a slight ochraceous tinge.

Type.— No. 110204, Am. Mus. Nat. Hist., ♂ ad., Andes west of Popayan (10,340 ft.), Colombia, July 16, 1911; W. B. Richardson.

Range.— Temperate Zone in the Central and Western Andes of Colombia (and southward on the Pacific side into Ecuador).

Remarks.— The single character on which this proposed form is based, though slight, appears to be constant and diagnostic. In a series of six specimens from Almaguer, south of Popayan and twelve specimens from the mountains west of Popayan only one cannot be at once distinguished

[1] Ex. Thayer and Bangs, Bull. M. C Z., XLVI, p. 96.
[2] Primaries not fully grown.

from any one of eight specimens from the Bogotá and Quito regions. Of these eight specimens four (one from near Bogotá and three from near Quito) were collected within the past two years and their agreement with the older native-made skins from these regions indicates that the latter have not changed in color. The Quito specimens (all native-made) are said to have been taken west of that city (according to Goodfellow (Ibis, 1901, p. 464) and are not found to the eastward, but if this be true it is difficult to explain the occurrence at Loja, in southern Ecuador, of the West Andean race here described. Nevertheless a specimen collected at Loja by Richardson has the flame-colored crest of the bird here named *ignicapillus*.

Iridosornis dubusia cæruleoventris subsp. nov.

Char. subsp.— Crest cadmium-orange, as in *I. d. ignicapillus* Chapm., but differing from that race and also from *I. d. dubusia* in having the ventral region and under tail-coverts dark blue of the same color as the belly, instead of chestnut-brown; and with no trace of chestnut on the under wing-coverts.

Type.— No. 134364, Am. Mus. Nat. Hist., ♀ ad., Paramillo (12,500 ft.), northern end of Western Andes, Colombia, Jan. 24, 1915; Miller and Boyle.

Range.— Temperate Zone at the northern end of the Western (and Central?) Andes, Colombia.

Remarks.— This very strongly characterized race is based on comparison of two females from the type-locality with twenty-six specimens of *I. d. dubusia* and *I. d. ignicapillus*. One of them has several chestnut feathers about the vent but the under tail-coverts are dark indigo-blue with no trace of chestnut. On the other hand, none of the twenty-six specimens of *dubusia* and *ignicapillus* is without a chestnut crissum.

The female of this species has been described as similar to the male but our excellent series shows that in the male the shining purple blue of the breast extends backward on to the flanks and abdomen, while in the female these parts are dull, dark, indigo-blue.

It is possible that the record of *Iridosornis dubusia* from Sta. Elena (Scl. & Salv., P. Z. S., 1879, p. 500) may refer to this species since there is a strong faunal affinity between that region and the Paramillo.

Cacicus uropygialis pacificus subsp. nov.

Char. subsp.— Resembling *Cacicus uropygialis microrhynchus* (Scl. & Salv.) in general dimensions but with the bill of much the same size and shape as in *C. u. uropygialis* Lafr.

Type.— No. 134533, Am. Mus. Nat. Hist., ♂ ad., Alto Bonito, R. Sucio, Chocó, Colombia, Feb. 17, 1915; Miller and Boyle.

Range.— Tropical Zone of the Pacific coast of Colombia from at least the Rio Salaqui southward into Ecuador, eastward into Antioquia.

Remarks.— Pacific coast specimens of *Cacicus uropygialis* have heretofore been referred to the 'Bogotá' form, *C. u. uropygialis* Lafr.[1] Reference, however, to the appended measurements show that they have the wing about 20 millimetres, the tail 35 millimetres shorter than in specimens from the Eastern Andes, while the tarsus and bill are proportionately smaller.

Specimens from Puerto Valdivia (alt. 360 ft.) on the lower Cauca show a slight approach in their longer tail to *uropygialis* but are still obviously referable to *pacificus*. Cauca Valley specimens as clearly represent the East Andean form. While "Los Tambos" and "Rio Lima," whence Batty secured the specimens listed in the accompanying table, are known to be in the vicinity of Cali, Batty's headquarters; their altitude is not stated. A juvenal female from Salento, having the tail 107 mm. in length, definitely establishes the occurrence of *uropygialis* at an altitude of 6500 feet, while two specimens from the west slope of the eastern Andes below Andalucia at an altitude of 5000 feet, suggest that it inhabits the Subtropical Zone.

From *Cacicus uropygialis microrhynchus* the proposed new form may at once be distinguished by its heavier bill, of which the culmen averages about 2 mm. wider basally. The gonydeal angle is broader, more obtuse, while the base of the mandible is much swollen. Many specimens, when seen from below, appear to have an enlargement laid on the sides of the base of the mandible from which it is raised by a ridge-like process.

In a specimen from Salaqui this growth is fully developed and the bird shows no sign of intergradation with *microrhynchus*. In others it is less prominent and it seems probable that the large and small-billed forms merge somewhere between the Canal Zone and the Colombian boundary.

Measurements of Males.

Name	Place	Wing	Tail	Tarsus	Culmen
C. u. pacificus	R. Salaqui, Col.	132.5	93.5	28	30
" " "	Alto Bonito, "	140	95.5	29.5	31
" " "	" "	136	90	28	29
" " "	" "	132	94	29.5	31
" " "	Baudo, "	130.5	92	29	30
" " "	" "	138	96	28.5	28
" " "	Barbacoas, "	141	96	29	32
" " "	Esmeraldas, Ec.	132	92	29.5	30.5

[1] *Cf.* Hellmayr, P. Z. S., 1911, p. 1121.

Name	Place	Wing	Tail	Tarsus	Culmen
C. u. pacificus	Esmeraldas, Ec.	131	93	28	30
" " "	"	136	91.5	30.5	31
" " "	"	142	96.5	30	30
" " "	Puerto Valdivia, Col.	137	101.5	29	30
" " "	" " "	139.5	104	28	31
C. u. uropygialis	Los Tambos, Cauca, Col.	157	131	33	33.5
" " "	Rio Lima, " "	161	135	32	30
" " "	" " "	162	133	33	32
" " "	Andalucia, Col.	153	125	31.5	32.5
" " "	Ecuador (Quito make) [1]	157	121	31	32.5

Measurements of Females.

Name	Place	Wing	Tail	Tarsus	Culmen
C. u. pacificus	Alto Bonito, Col.	123	84	29	29.5
" " "	" "	126	90	30	29.5
" " "	" "	123.5	88	26.5	27
" " "	La Vieja, Chocó, Col.	111.5	82.5	26.5	27
" " "	Barbacoas, "	117	86	26	25
" " "	Esmeraldas, Ec.	118.5	86.5	28	29
" " "	" "	123	86	27.5	28
C. u. uropygialis	Andalucia, Col.	142	117	33	30
" " "	Ecuador (Quito make) [2]	140	114	32	30

Amblycercus holosericeus flavirostris subsp. nov.

Char. subsp.— Similar to *A. h. holosericeus* (Licht.) but smaller, the bill (in skins) mustard-yellow rather than greenish horn-color, the culmen averaging broader and flatter, squarer, less pointed anteriorly, less rounded posteriorly.

Type.— No. 118354, Am. Mus. Nat. Hist., ♀ ad., Barbacoas, Nariño, Colombia, Aug. 13, 1912; W. B. Richardson.

Range.— Tropical to Temperate Zone in Colombia from the Pacific coast eastward at least to the summit of the Eastern Andes; southward into Ecuador, along the Pacific coast region at least to Guayaquil.

Remarks.— Our fourteen Colombian and Ecuadorian specimens differ so constantly and strikingly in color of the bill from our twenty-seven specimens from Central America and Mexico (eastern Panama to Tampico) that even those specimens from the localities nearest each other (El Real, Panama and Alto Bonito, lower Atrato Valley) show no signs of intergradation. Age of the skin apparently does not effect this character; old skins of both *holosericeus* and *flavirostris* having the bill of the same color as in freshly collected ones. Apparently there is but little post-mortem change. The bill of *holosericeus* in life is described by Salvin & Godman (Biol. Cent.

[1] See foot-note under females.

[2] A second skin of the same make from Quito measures wing, 157; tail, 121; tarsus, 31; culmen, 32.5. Both are unsexed but the larger is assumed to be a male, the smaller a female.

Am., Aves, I, p. 447) as "yellowish green" and Carriker (Bds. Costa Rica, p. 833) speaks of it as "pale pea-green." The bill of *flavirostris,* on the other hand, is described by Richardson (field labels) as "yellow"; Palmer, as quoted by Hellmayr (P. Z. S., 1911, p. 1122), describes it as "light yellow," and Festa, as quoted by Salvadori and Festa (Bull. Mus. Tor., XV, 1899, p. 28), gives it as "giallo."

This yellow color, while somewhat lighter apically, extends to the very base of the bill, whereas in *holosericeus* the bill basally is in whole or part more or less plumbeous.

The character of size is less diagnostic. Mexican birds, however, appear never to be as small as South American ones, but Ridgway's tables of measurement (Bull. 50, II, p. 194) include Guatemalan specimens which are as small as those from Ecuador. I suspect, however, that some of the apparent variations in size noted, both individual and geographic, are due to erroneous sexing, since the sexes cannot always be distinguished in color. As the appended table shows, our largest specimen of *holosericeus* is also our most southern one, and in the color of the bill also it shows no approach toward *flavirostris.*

Hellmayr (*l. c.*) records a female specimen of "*Amblycercus holosericeus*" having the "bill light yellow" from Guineo, Rio Calima, in the Tropical Zone of western Colombia, and our specimens of the yellow-billed form are from the following localities:

Colombia: 'Bogotá,' 2; El Piñon (9600 ft.), E. Andes near Bogotá, 1; Rio Toché, Cen. Andes, 1; Los Tambos, Cauca region (Batty), 1; Alto Bonito, lower Atrato, 1; Barbacoas, 1. *Ecuador;* Esmeraldas, 4; Naranjo, 2; Santa Rosa, 1; Guayaquil, 1.

Measurements.

Place	Sex	Wing	Tail	Tarsus	Culmen
Tampico, Mex.	♂	103	109	34	31.5
Tamiahua Lag., Mex.	♂	100.5	108	33.5	30
Gatun, Panama	♂	103	99	34	29.5
La Chorrera, Panama	♂	105.5	—	32.5	30.5
El Real, "	♂	106	98.5	34	33
Esmeraldas, Ecuador	♂	99	92	31	29.5
" "	♂	98	96	30	29
Naranjo, "	♂	98	96	32.5	28
Guayaquil, "	♂	96	92	30	31
Jalapa, Mexico	♀	89	98	31	27
Tlacotalpam, Mexico	♀	94	96	31.5	29
El Piñon (near Bogotá), Col.	♀	82	88	28.5	24.5
Rio Toché, Col.	♀	83	87	30	24.5
Barbacoas, "	♀	89	92	30	29
Esmeraldas, Ec.	♀	92	95	30	28
Santa Rosa, "	♀	87.5	86	30	26
Naranjo, "	♀	83	82	29	26

Molothrus bonariensis æquatorialis subsp. nov.

Char. subsp.— Size smaller than that of *M. b. cabanisi,* larger than that of *M. b. bonariensis;* the male resembling in color the males of other forms of this species; the female decidedly darker than the female of *M. b. cassini* and still darker than the female of *M. b. occidentalis,* much nearer the females of *M. b. atronitens* amd *M. b. bonariensis,* but much larger than the former, somewhat larger than the latter and with a larger, heavier bill.

Type.— No. 118355, Am. Mus. Nat. Hist., ♀ ad., Barbacoas, Narino, southwestern Colombia; August 5, 1912; W. B. Richardson.

Range.— Tropical Zone of the Pacific coast from extreme southwestern Colombia, south at least to the Province of Guayas, Ecuador.

Remarks.— After discovering that the strongly marked form *Molothrus bonariensis cabinisi* (Cass.) occupies, with no apparent variation, the greater part of Colombia west of the Andes and even appears on the west slope of the Western Andes at Caldas, it was surprising to find that the Cowbird of southwestern Colombia and western Ecuador more nearly resembles *M. b. bonariensis,* both in color and in size, than it does the race to which, geographically, it is so much nearer. The absence of specimens from the Pacific coast (except from the Caldas pocket, which is believed to be an extension of the Cauca Valley fauna) north of the Patia, induces the belief that, as in some other cases, the relationships of the Ecuador and southwest Colombia race is actually with the upper Amazonian form rather than with that to the north of it.

Molothrus bonariensis occidentalis (Berl. & Stolz.), of which I have a topotypical female, is evidently a pale form (paler even than *cabanisi*) from the arid Peruvian coast. A specimen from Daule near Guayaquil is the palest of my five females of *œquatorialis,* and it may represent an actual approach toward *occidentalis.* A male in juvenal plumage from Puna Island is conspicuously paler than males in corresponding plumage from Barbacoas and Tumaco. Puna Island, however, is in the arid coastal zone and it is not improbable that specimens from this region should be referred to *occidentalis.* The remaining female specimens of *œquatorialis* (Barbacoas, 1; Esmeraldas, 3) are all much darker, more blackish than any one of seven females of *atronitens* from Trinidad and the Paria Peninsula or of two females of *M. b. bonariensis,* one of which is from Conchitas near Buenos Aires, the type-locality of this race.

Though closely approaching the latter form in size, *œquatorialis* has a much heavier bill, and in this respect it resembles *M. b. bonariensis.* Measurements of the various forms are appended.

Measurements.

Name	Place	Sex	Wing	Tail	Tarsus	Culmen
M. b. cassini,	Santa Marta, Col. (Type).	♂	131.5	100.5	30	20.5
" " "	" "	♂	122.5	95.5	29.5	20.5
" " "	San Agustin, "	♂	125	100.5	30	21
" " "	Miraflores, "	♂	129	103.5	29.5	21
" " "	" "	♂	126	101	29	21
" " "	Cali, "	♂	129.5	101.5	29.5	21.5
" " "	San Antonio, "	♂	128	104	29.5	20
" " "	" "	♂	126.5	96.5	29.5	—
" " "	Caldas, "	♂	132	101.5	29	20
" " "	" "	♂	126	100	29.5	21
M. b. æquatorialis,	Tumaco, "	♂	119	97.5	28	21
" " "	Esmeraldas, Ec.	♂	121	91.5	29.5	22
" " "	" "	♂	114	88.5	28.5	20
" " "	" "	♂	118.5	88	28.5	20.5
" " "	Manavi, "	♂	122.5	95	28	21
" " "	" "	♂	120	91	29.5	21.5
M. b. cassini,	Santa Marta, Col.	♀	105	80.5	27	18
" " "	San Agustin, "	♀	108	83.5	28	19
" " "	Miraflores, "	♀	110	88.5	27.5	18
" " "	Cali, "	♀	111	89	27.5	18.5
" " "	" "	♀	113	90	27	19.5
" " "	San Antonio, "	♀	108.5	85	28	19.5
" " "	Caldas, "	♀	111.5	88.5	27	18
M. b. æquatorialis,	Barbacoas, "	♀	103.5	78	27	20
" " "	Esmeraldas, Ec.	♀	104	79.5	26	17
" " "	" "	♀	99.5	76.5	26.5	19.5
" " "	" "	♀	105	79.5	28	19
" " "	Daule, "	♀	100	77.5	26	18

INDEX TO VOLUME XXXIV.

New names of genera, subgenera, species, and subspecies are printed in **heavy-faced type**, also the main references in a series of references.

(*Continued from 4th page of cover.*)

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(*Continued on 2d page of cover.*)

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(*Continued on 3d page of cover.*)